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Wood Waste Inventory: Final Report

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Wood Waste Inventory

Final Report

Project Officer/Technical Lead

Anthony T. Zimmer, Ph.D., P.E.
U.S. Environmental Protection Agency
Office of Research and Development
26 Martin Luther King Drive
Cincinnati, OH 45268

Project Authors

Keith Weitz, Aditi Padhye, Samantha Sifleet
RTI International
3040 E. Cornwallis Road
Research Triangle Park, NC 27709

Helena-Solo Gabriele
University of Miami
1251 Memorial Drive
Coral Gables, FL 33146

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ACRONYMS

ACQ	alkaline copper quat
CA	copper azole
CCA	chromated copper arsenate
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
MCA	micronized copper azole
MCQ	micronized copper quat
MSW	municipal solid waste
SFPA	Southern Forest Products Association
SHC	Sustainable & Healthy Communities
SMM	Sustainable Materials Management

KEY TERMS AND DEFINITIONS[1]

Consumption: The process by which a product is used by the intended user.

Disposal: The process by which generated waste is ultimately removed with the primary intent of removing it from contact with the public. Examples of ultimate disposal include landfill or incineration.

Dimensional wood: Wood cut into shapes used for construction (e.g., houses, buildings, decks) and non-construction applications (e.g., telephone poles, furniture).

Generation of waste: The process of discarding materials that have reached the end of their service life for their original intended use. Some of the discarded material can be recycled or reused.

Harvest residues: The portion of the cut trees that are not used to produce logs and typically composed of branches, stumps, and other parts of trees.

Life-cycle assessment: A method of assessing environmental impacts associated with a product's life stages, from raw materials extraction through production, distribution, use, and end-of-life management.

Logs: Wood harvested from trees and transported to sawmills for production of dimensional wood.

Lumber: Wood product category that is comprised of sawn hardwood and softwood products whose least dimension is less than 5 inches (e.g., 2 x 10, 3 x 8).

Industrial wood products: Cooperage logs, poles and pilings, fence posts, hewn ties, round mine timbers, box bolts, excelsior bolts, chemical wood, shingle bolts, and miscellaneous items.

Paper and paperboard: Wood product category that is comprised of pulp, paper, and paperboard products made from wood.

Plywood and veneer: Wood product category that is comprised of hardwood plywood and veneer and softwood plywood.

Production: The process of manufacturing wood products for consumer, commercial and industrial use.

Off-cut: The minor losses of production by consumers as they use the wood products for their intended purpose.

Timbers: Wood product category that is comprised of sawn products whose least dimension is 5 inches or more (e.g., 5 x 7, 6 x 8)

Service life of wood products: The period after installation or use during which a wood product meets or exceeds its performance requirements.

Wood panel products: Wood product category that is comprised of hardboard, insulating board, and particle board.

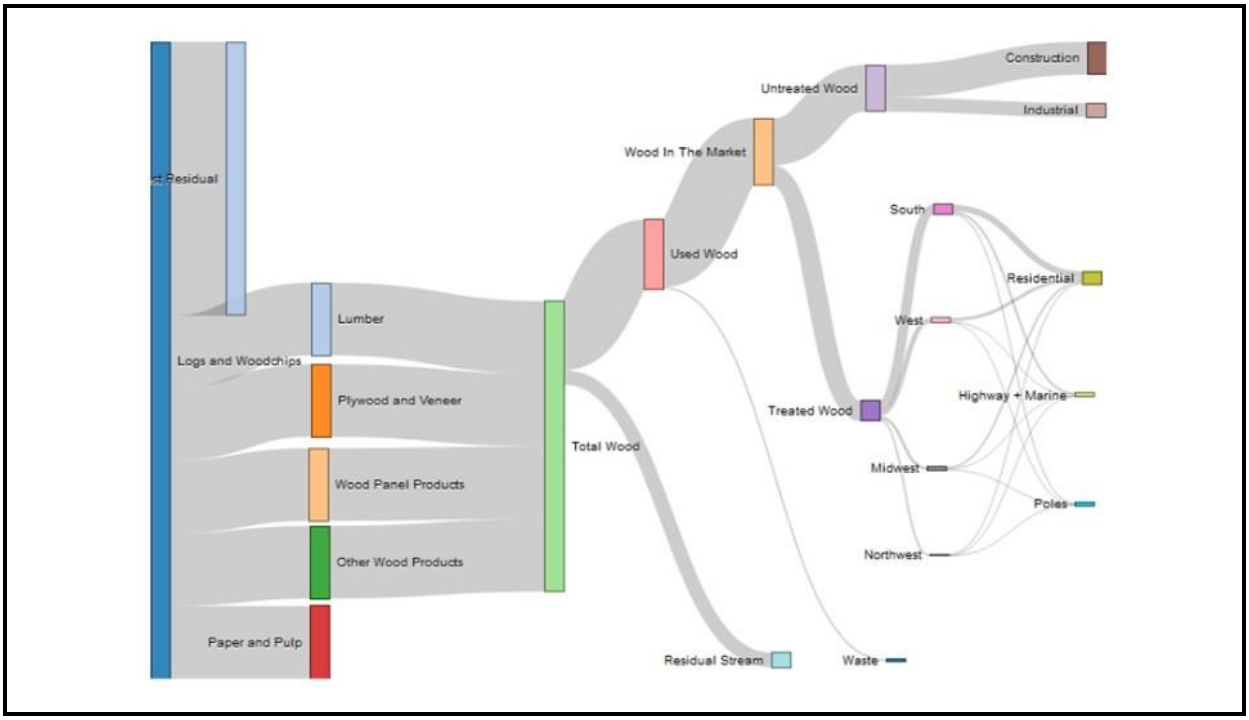
[1] Definitions do not correspond to EPA statutory, regulatory, or programmatic definitions. They are provided strictly for the purposes of understanding the meaning of terms as used in this document.

EXECUTIVE SUMMARY

According to EPA (2016), large volumes of wood waste are generated each year in the United States that require disposal, reuse, or other end-of-life management. Dovetail Partners (2014) estimated that more than 64 million metric tons of wood waste was generated in 2010 with 28 million metric tons recovered, 27 million metric tons still available for recovery, and 10 million metric tons non-recoverable. As cities and solid-waste management planners strive to increase the reuse and recycling of wood wastes to divert the material away from landfill disposal, it is important to know the current and projected future amounts of wood that may enter the waste stream as well as characteristics of wood (e.g., untreated, treated) that may impact its reuse or recyclability.

The primary objective of this report is to develop an inventory of wood production and consumption, and quantify the amount entering the waste stream and remaining in service in the continental United States. An example of the flow of wood product, specifically focused on lumber for simplicity, is shown in **Figure ES-1**. The inventory captures the stages of the life cycle from resource stock (i.e., logs) to specific wood product application (e.g., treated lumber used in residential outdoor applications in the South region of the United States). The inventory was constructed using publicly available data from the U.S. Census Bureau and U.S. Forest Service characterizing national-level log and wood product production.

Figure ES-1. Flow of Wood Through the U.S. Economy (Lumber Product Example)



A mass flow approach was used to estimate wood waste generated and wood remaining in service for each study year from 1900 to 2065. As shown in Equation ES-1, the amount of wood remaining in service each year is the difference between the amount of wood product produced and the amount entering the waste stream over the range of years starting with 1900 and ending with 2065. The year 1900 was used as the start date as that is the first year for which data are available for wood production and consumption.

$$Si = \sum_{1900}^{i} Pi - \sum_{1900}^{i} Gi \qquad \text{(Equation ES-1)}$$

Where:

S_i = Wood Remaining In Service for year i

$P_i = P_{UC,i} + P_{UI,i} + P_{TR,i} + P_{TH,i} + P_{TU,i}$

$P_{UC,i}$ = Production of Untreated Construction Wood for year i
$P_{UI,i}$ = Production of Untreated Industrial Wood for year i
$P_{TR,i}$ = Production of Treated Residential Wood for year i
$P_{TR,i}$ = Production of Treated Highway and Marine Wood for year i
$P_{TU,i}$ = Production of Treated Utility Poles for year i

$G_i = W_{ip} + W_{iu} + G_{UC,i} + G_{UI,i} + G_{TR,i} + G_{TH,i} + G_{TU,i} + C_i$

W_{ip} = 5% production stage residual waste for year i
W_{iu} = 2.5% use stage off-cut waste for year i
$G_{UC,i}$ = Generation of Untreated Construction Wood Waste for year i
$G_{UI,i}$ = Generation of Untreated Industrial Wood Waste for year i
$G_{TR,i}$ = Generation of Treated Residential Wood Waste for year i
$G_{TH,i}$ = Generation of Treated Highway and Marine Wood Waste for year i
$G_{TU,i}$ = Generation of Treated Utility Poles Waste for year i
C_i = Catastrophic Loss for year i

The amount of wood entering the waste stream in each year is based on the useful service life (lifetime) of various wood products in various regions of the United States and various end-use applications. Service life categories that were developed by expert judgment based on the service life estimates in the literature and employed in the inventory are as follows:

- 10 years—Treated lumber and timbers used for residential applications
- 25 years—Treated lumber and timbers used for highway, commercial, and industrial applications
- 40 years—Treated poles and piles
- 50 years—Untreated wood used for industrial applications
- 70 years—Untreated wood used for residential applications

Figure ES-2 illustrates the amounts of wood waste (treated, untreated, and total wood) generated each year during our study period of 1900–2065. Note that since different wood products have different service lives, not all the wood generated in 1900 entered the waste stream at the same time. For example, only in 1970 will all the untreated wood used for residential applications consumed in 1900 have entered the waste stream. Therefore, a "ramp up" effect is portrayed in the data for 1970. In addition, our most recent year for wood product production and consumption data is 2011, yet our study period extends through 2065, so there would also be a "ramp down" effect unless future wood production and consumption were estimated. Estimated wood product production and consumption levels through 2065 are based on U.S. economic forecasts, which are strongly correlated with construction activity.

Figure ES-2. Annual Generation of Treated, Untreated, and Total Wood Waste, 1900–2065

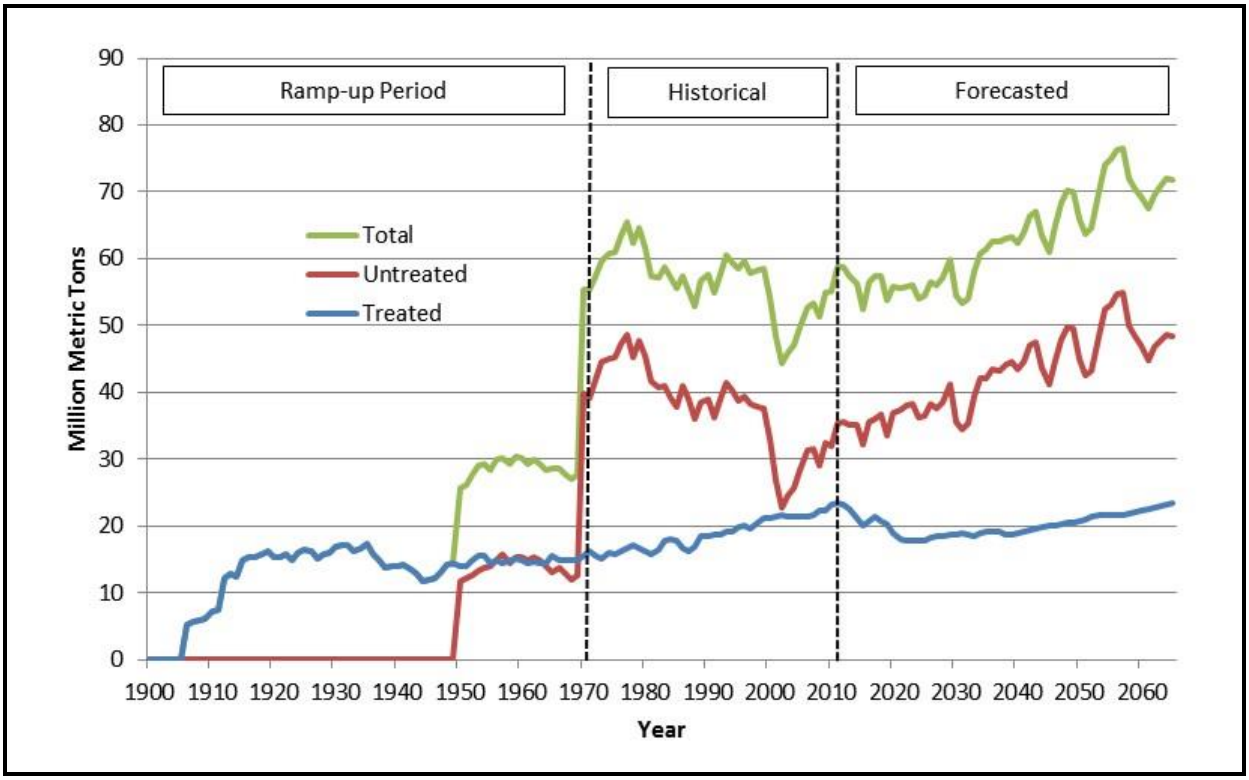
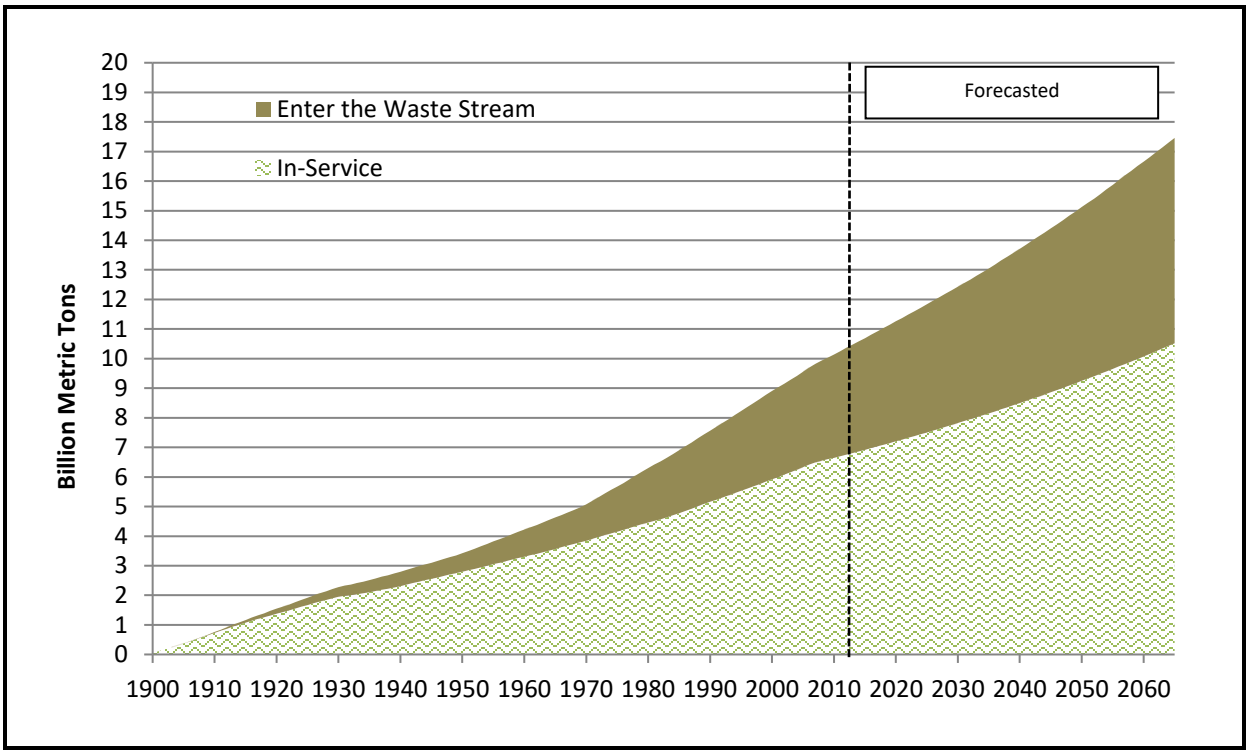


Figure ES-3 illustrates the cumulative amounts of wood waste generated and wood that remains in service over the study period of 1900–2065. As defined by Equation ES-1, the wood remaining in service is calculated as the difference between wood produced and wood waste generated over the years including and prior to the year of interest. As shown in **Figure ES-3**, a cumulative amount of approximately 3.5 billion metric tons of wood waste has been generated since 1900 and approximately 6.7 billion metric tons of wood remained

in service in the United States as of 2011. By 2065, a forecasted cumulative 6.9 billion metric tons of wood waste will have entered the waste stream and a forecasted cumulative 10.5 billion metric tons of wood will remain in service (and will enter the waste stream in the post-2065 years).

Figure ES-3. Cumulative Amounts of Wood Entering the Waste Stream and Wood Remaining In Service in the United States, 1900–2065



Wood waste from other sources including catastrophic events (e.g., hurricanes, floods, and fires) and woody biomass from the municipal solid waste (MSW) stream were also approximated. If catastrophic wood debris were included in **Figures ES-2** it would add approximately 1 million metric tons per year. If woody biomass from MSW were included in **Figure ES-2**, it would add an additional 17 million metric tons per year.

The approach used to develop the wood waste inventory can be repeated for other types of materials to estimate the quantities of these other materials that are in service or were generated as waste. Estimated amounts of wood in service or generated, coupled with projections of future consumption, provide valuable insight into potential opportunities for more efficient materials management (e.g., to meet consumption demands, wood products could be sourced through reclamation of landfills instead of traditional natural resource extraction).

Key findings from the inventory include:

- The projected amount of wood waste generated in the United States will continue to increase in a linear fashion. However, an uptick in wood waste generated will occur during the last half of the future forecast (2045–2065) as up until 2005 wood consumption was still increasing.
- The projected generation of untreated wood waste will outpace treated wood waste in future years. By 2050, the amount of untreated wood waste generated is estimated to be more than double the amount of treated wood waste.
- The shorter service life for treated wood impacts the cumulative amount of treated versus untreated wood remaining in service. Treated wood appears to move in and out of service relatively quickly, and the cumulative amount remaining in service is relatively constant. Untreated wood drives most of the wood remaining in service.
- There are regional differences that impact wood consumption and waste generation. The South consumes approximately 50 percent of wood product produced. Thus, there is significantly more wood waste generated in the South. For cumulative amounts of wood remaining in service; however, the story differs by type of wood. For treated wood, the wet weather in the South shortens the service life and thus less wood remains in service over time than in other regions (e.g., the arid West). Untreated wood is typically used for indoor applications and is less impacted by weather. In line with the significantly higher consumption of wood in the South, the cumulative amount of untreated wood remaining in service is significantly higher in this region than the rest of the country.
- The amount of wood waste residuals generated from wood product manufacturing has decreased by approximately 30 percent in the last 50 years. Given the hundreds of millions of metric tons of wood product produced, the amount of wood waste reduction from production efficiency improvement is significant and currently in the tens of millions of metric tons per year.

1. INTRODUCTION

1.1 Background

Accurate estimates of amounts of materials in various phases of their life cycle would provide valuable insight into potential opportunities for more efficient materials management (e.g., opportunities to expand reuse, recycling, or reclamation of material from landfills instead of traditional natural resource extraction). Recovery and subsequent reuse or recycling of wood and other common materials conducted in a manner protective of human health and the environment is a key part of the U.S. Environmental Protection Agency's (EPA's) Sustainable Materials Management (SMM) effort. SMM is a systems approach that seeks to reduce materials use and their associated environmental impacts over their entire life cycle, starting with extraction of natural resources and product design and ending with decisions on recycling or final disposal.

The amount of wood waste generated may also be of interest under the Sustainable and Healthy Communities (SHC) research project. The SHC research action plan seeks to find ways to integrate environmental, economic, and social considerations into decision-making processes at various levels of government (i.e., federal, state, local). The beneficial reuse of waste materials is an important research focus of the SHC program. By researching beneficial reuse of waste material, the broader SHC program is expected to influence decision making and achieve measurable results.

Reuse and recycling can result in numerous benefits, including decreasing the use of virgin materials in products or processes, creating economic development opportunities for material recyclers, and generating social benefits (e.g., preservation of forests). However, if reuse is not conducted in a manner protective of human health and the environment, adverse impacts may also arise. Decision makers for proposed beneficial reuse projects must balance the objectives of promoting waste materials reuse and resource conservation with the need to protect human health and the environment, as well as achieving favorable economic and social outcomes.

1.2 Report Objectives and Scope

The primary objective of this wood waste inventory is to develop a quantitative, transparent, and repeatable approach and methodology for estimating quantities of wood throughout resource (dimensional wood) production, wood product manufacturing, wood product use, and as wood waste generated at the end of the wood products' useful service life. Another objective is to develop projections for the amounts of wood by type (e.g., untreated and treated) that will enter the waste stream or remain in service for the next 50 years. To meet these objectives, a materials flow analysis approach and methodology was employed.

The inventory for wood captures the full life cycle of wood products including the initial resource stock (logs from forests), production and use of dimensional wood, and through to the generation of wood waste at the end of the service life for different wood products. Additional scope and boundaries for the inventory are defined as follows:

- ***Materials*** included in the inventory include logs, lumber, plywood and veneer, and panel and industrial as these are the main material categories reported by the U.S. Census Bureau and Forest Service. As part of this study, wood products were further categorized as treated or untreated. Other wood products, such as paper products, are not included in the estimates for wood waste generation.
- ***Geographic scope*** of the wood inventory is the United States and captures imports and exports of timber and wood products into and out of the country.
- ***Temporal boundaries*** are defined using a base year of 2011, which reflects the latest wood data available, to the year 2065. To account for the potential long service life of wood products, data for wood product production was obtained for the period 1900–2011.
- ***Unit of measure*** for the inventory is metric tons. Wood-related data are found in various units from volume (cubic feet and board feet) to mass (tons).

Note that the focus of the inventory was estimating wood waste generation and wood remaining in service. Amounts of wood disposed or recovered and subsequently reused or recycled were not captured as part of the inventory.

1.3 Conceptual Approach

The conceptual approach for constructing the wood waste inventory was designed to quantify the flow of wood through the United States from harvesting of timber from forests, production and use of wood products, and generation of wood waste during production and installation activities as well as at the end of the service life for different wood products.

A materials flow approach for wood based on Solo-Gabriele et al. (1998) was built upon to meet this objective. The materials flow approach is a standard method used to characterize the flow of materials from location to location within a defined geographic and/or temporal boundary. The approach has been used to support environmental decision making (Brunner and Rechberger, 2004) and to characterize MSW streams (EPA, 2016). In the case of wood waste, the materials flow approach helps to understand the pathways and the intermediate and final destinations of wood products with varying service lifetimes. After the material flows are understood, decision makers can better manage the wood waste to promote reuse and recycling.

Traditionally, a materials flow approach consists of the following components:

- system boundary (temporal, spatial, or both),
- processes (the number and type of processes to focus on),

- flows (how the products move from one process to another), and
- stocks (the quantity of products that flow through the system boundary).

The Solo-Gabriele et al. (1998) approach was developed to estimate treated wood waste generated and remaining in service in the state of Florida. This approach was expanded to capture treated and untreated wood waste generation and wood remaining in service across the entire United States.

The implementation of the materials flow approach consisted of using readily available data for timber and wood product production—to which assumptions were applied to estimate production losses and off-cuts—in combination with a wood waste generation model developed through this project that uses wood product consumption and product service life assumptions to estimate the timing of when different wood products will reach the end of their useful service life and enter the waste stream.

Data for dimensional wood production were reviewed and compiled from U.S.-level data sources, primarily the U.S. Census Bureau (2015a) and U.S. Forest Service (Howard, 2013). Data were available for logs harvested and dimensional wood production for 1900–2011. The high-level categories of wood considered included dimensional wood, which is separated into untreated wood and treated wood. Broad categories of specific dimensional wood products, such as 2x4s, are reported by the U.S. Census Bureau and Forest Service. Additional details for treated wood used in decking and marine wood products were available from the South Forest Products Association (SFPA, 2009) and were used to approximate the amounts of treated and untreated wood product.

A general assumption was made that a fraction of dimensional wood production (95 percent based on Howard, 2013) was consumed for any given year, suggesting a loss of 5 percent in the transition between log inputs and dimensional wood product to the actual consumer (e.g., construction firm, residential home owner). A second loss of 2.5 percent was assumed (Solo-Gabriele, 2016) by the consumer, which we term "off-cut" waste. Given these losses, a computational model based on wood product usage and anticipated service life assumptions was developed to generate estimates of wood waste entering the waste stream and remaining in service for any given year. Wood product service life is varied by type of wood (treated or untreated), end-use application (e.g., home construction, decking, marine), and U.S. region of use.

Unlike wood production statistics, data characterizing the amount of treated and untreated wood in the U.S. waste stream are not as readily available. In addition, different wood products and uses have different life expectancies. Estimates for the amounts of wood at its end-of-life are generated using overall wood production data in combination with production losses, industry and other statistics about the fractions of treated and untreated wood, installation losses, and life expectancies of different wood products in use applications.

The materials flow approach was used to estimate the amounts of wood at its end-of-life and wood remaining in service for each study year. As shown in Equation 2-1, the amount of wood remaining in service is calculated as the difference between the amount of wood product produced and the amount entering the waste stream in each year.

$$Si = \sum_{1900}^{i} Pi - \sum_{1900}^{i} Gi$$

(Equation 2-1)

Note that the approach assumes that the amount of wood product produced and consumed are the same for each year. The amount of wood reaching its end-of-life in each year is defined by the service life of different treated and untreated wood products and the production and installation losses. For example, treated lumber used for residential decks may have an average service life of 10 years while utility poles have an average service life of approximately 40 years. Furthermore, untreated wood used in residential construction can last more than 50 years.

The conceptual approach for constructing the wood waste inventory is illustrated in **Figure 1-1**. A computational model was in the statistical software R to enable easy modification of service lives and other key assumptions.

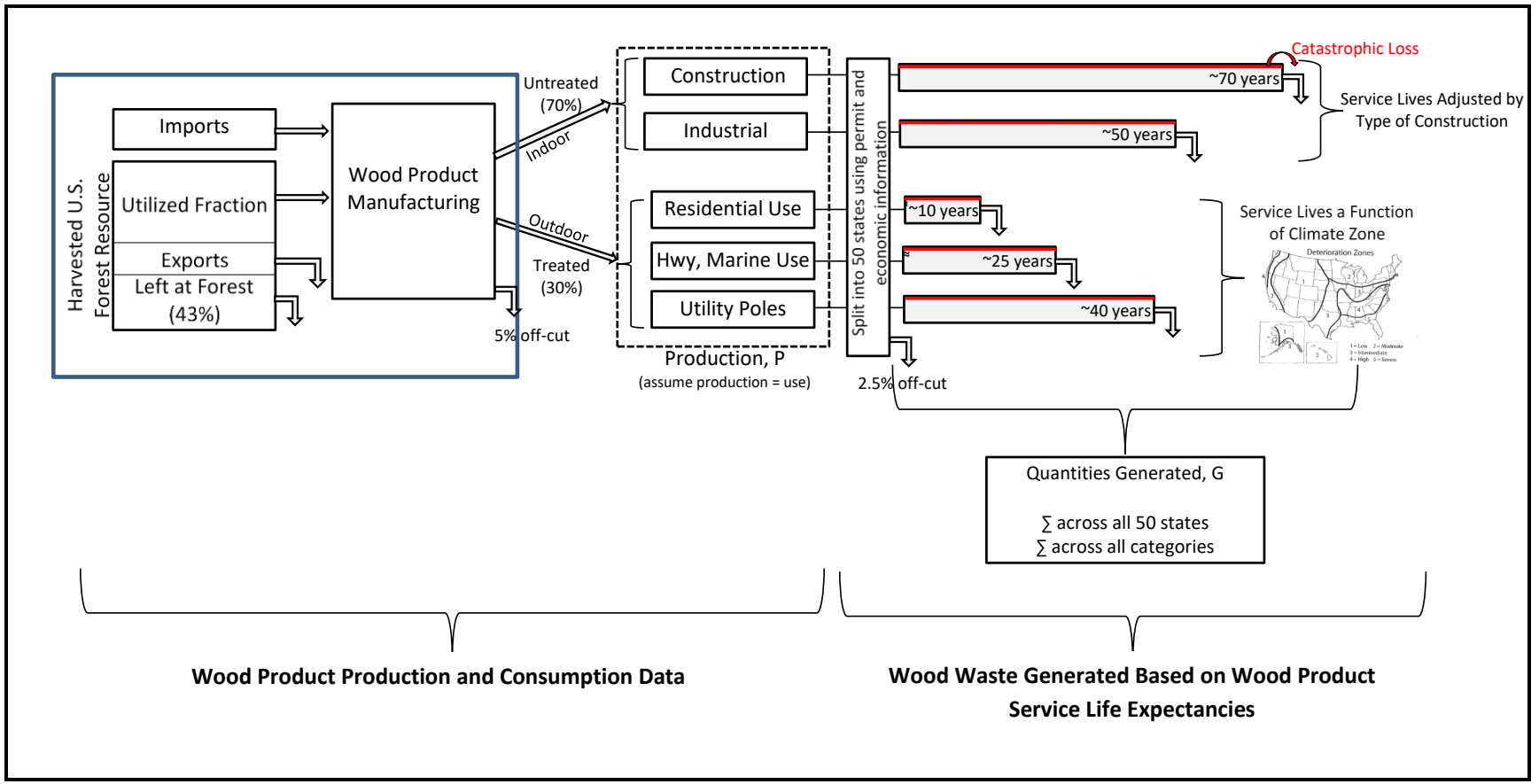
1.4 Report Use and Structure

The intended audience for this report includes U.S. governmental agencies, state/local governmental agencies, industry, non-governmental organizations, and the research community. The data and information contained in this report are intended for use in providing a macro-level view of the flow of wood through the U.S. economy and anticipated generation of wood waste over time.

The remainder of this report is organized into three sections. **Section 2** presents the methodology, data and key assumptions employed for wood product production, consumption, and service lifetimes. **Section 3** presents results for wood waste generation and wood that remains in service. **Section 4** summarizes findings and presents potential future improvements and research needs.

Appendix A includes the detailed data for logs and wood product production as compiled from U.S. government sources as well as data calculated to fill gaps in historical data and future forecasts. **Appendix B** contains the detailed results of the wood waste inventory model including wood waste generated, wood remaining in service, and U.S. regional estimates for wood waste generated and wood remaining in service.

Figure 1-1. Overall Conceptual Approach for the Wood Waste Inventory



1.5 Quality Assurance and Data Limitations

This project involved collecting and analyzing secondary data and developing an analytical approach for constructing the wood waste inventory. The inventory uses wood production and consumption data in combination with time series data for wood product service lifetimes. In addition, the authors have applied their own assumptions to develop splits for untreated and treated wood, production and consumption residuals, as well as consumption patterns by region of the United States.

This work was conducted under an approved Quality Assurance Project Plan. The appropriateness of the data and their intended use were assessed with respect to the data source, the data collection timeframe, and the scale of the geographic area that the data represent. Preference was given to data that have undergone peer or public review (e.g., those published in government reports and peer-reviewed journals) over data sources that typically do not receive a review (e.g., conference proceedings, trade journal articles, personal estimates). However, where peer-reviewed data did not exist, parameters and assumptions were developed from the next highest quality available sources (e.g., grey literature, and product specification data sheets from manufacturers). Preference was given to more recent data over older data. In this report, the sources of all data and any identified assumptions and limitations are presented.

2. COMPUTATIONAL METHODOLOGY, DATA AND KEY ASSUMPTIONS

A key objective of this report was to develop a methodology for estimating the amount of wood waste generated and the amount of wood remaining in service for historical and future years. In this section, the computational methodology used to implement the mass flow approach to estimate wood waste generated and wood remaining in service is described. Key assumptions that are employed in the methodology, such as wood product service life assumptions, are detailed. Approaches for additional elements that were considered in developing the wood waste inventory, including regional variation in wood service life and wood waste generated via catastrophic events such as hurricanes also are presented.

2.1 Computational Methodology

The computational methodology used to estimate the amount of wood waste generated and wood remaining in service for each study year is based on a materials flow approach. The basic approach is expressed by the following equation:

$$Si = \sum_{1900}^{i} Pi - \sum_{1900}^{i} Gi$$

(Equation 2-1)

Where:

S_i = Wood Remaining In Service for year i

$P_i = P_{UC,i} + P_{UI,i} + P_{TR,i} + P_{TH,i} + P_{TU,i}$

$P_{UC,i}$ = Production of Untreated Construction Wood for year i

$P_{UI,i}$ = Production of Untreated Industrial Wood for year i

$P_{TR,i}$ = Production of Treated Residential Wood for year i

$P_{TR,i}$ = Production of Treated Highway and Marine Wood for year i

$P_{TU,i}$ = Production of Treated Utility Poles for year i

$G_i = W_{ip} + W_{iu} + G_{UC,i} + G_{UI,i} + G_{TR,i} + G_{TH,i} + G_{TU,i} + C_i$

W_{ip} = 5% production stage residual waste for year i

W_{iu} = 2.5% use stage off-cut waste for year i

$G_{UC,i}$ = Generation of Untreated Construction Wood Waste for year i

$G_{UI,i}$ = Generation of Untreated Industrial Wood Waste for year i

$G_{TR,i}$ = Generation of Treated Residential Wood Waste for year i

$G_{TH,i}$ = Generation of Treated Highway and Marine Wood Waste for year i

$G_{TU,i}$ = Generation of Treated Utility

C_i = Catastrophic Loss for year i

The main steps taken to implement the materials flow methodology for wood include the following:

1. *Estimate timber production and imports/exports.* U.S. Census and U.S. Forest Service data were used to obtain estimates for timber harvested as well as imports and exports of timber. Harvest loss rates were obtained from the U.S. Department of Energy (2011).
2. *Estimate wood production and residual by product type.* Census and Forest Service data were used to obtain estimates of wood product manufacturing by high-level product category. Manufacturing residual waste is generated and captured using the difference between the tonnage of log input to production and the tonnage of wood product output, which is assumed to be 5 percent. This residual enters the waste stream within the same year that the wood product was produced.
3. *Estimate wood consumption and residual by end-use application.* Census and Forest Service data were used to obtain estimates of wood consumption by sector and application. A simplifying assumption is made that the amount of wood product produced and consumed are the same for each year. Off-cut waste is generated when the wood is first used (i.e., trimmed to size) for construction purposes and is assumed to be 2.5 percent (Cooper, 1993) that enters the waste stream within the same year that the wood was produced.
4. *Estimate wood service life by end-use and region.* Service life assumption were adopted by general wood product category (treated and untreated) and end-use application (indoor and outdoor residential, industrial, marine, telephone pole). Service life assumption were further refined to included US regional adjustments to account for the impact on climate on service life for outdoor applications.
5. *Calculate time series of wood in-service and wood waste generated.* Estimates for the amounts of wood at its end-of-life are generated using generic wood production data in combination with production losses, industry and other statistics about the fractions of treated and untreated wood, installation losses and life expectancies of different wood products in use applications. For example, treated lumber used for residential decks may have an average service life of 10 years while utility poles have an average service life of approximately 40 years, and untreated wood used in residential construction can last more than 50 years.

These steps are detailed in the following sections.

2.2 Data for Wood Production and Consumption

To apply the materials flow approach to estimate wood waste generated and wood remaining in service in the United States, data are needed for characterizing the wood resource stock (forest resources) and production and consumption of dimensional wood products. The data also need to capture imports and exports of logs and dimensional wood as well as residual or loss rates associated with forest harvesting and dimensional wood production to provide a complete picture of the flow of wood through the U.S. economy.

One aim in developing the characterization of dimensional wood production was to utilize data that are regularly updated from publicly available sources so that the approach could be readily duplicated and applied to other materials. The U.S. Forest Service (Howard, 2013) was found to provide the most robust source of data capturing the macro-level production statistics. These data are updated regularly, as they are also used by the U.S. Census Bureau (2015a). Although these data are good for capturing U.S. macro-level

statistics for high-level product categories (e.g., dimensional lumber), they do not provide the detail needed to, for example, adequately characterize the amount of treated versus untreated wood product or the location for where wood products are consumed. Thus, the U.S. macro-level data from the U.S. Forest Service were supplemented with additional sources to capture all the desired elements of the inventory, including:

- Residuals from the harvesting of logs that are left in the forest
- Residuals generated during the production of dimensional wood and during the consumption of wood products, which we refer to as off-cut
- Breakdown for treated and untreated wood product production
- Location where treated wood products are used to account for service life differences that result from the varied environmental conditions across the United States
- End use for untreated and treated wood products to account for service life differences.

One challenge that is somewhat unique to the wood industry is that not all wood products are measured in the same units. Volumes (e.g., cubic feet, square feet, board feet) are commonly used and in some cases mass (e.g., tons) of timber or wood product are provided. To provide consistency in our wood inventory, our desire was to use the common unit of metric tons. Data in metric tons of logs harvested and wood product production were available from the U.S. Geological Survey (2013). Other data, such as treated wood production from SFPA (2009) were converted from board feet to metric tons using a factor of 1.1 thousand board feet per metric ton based on a weighted average (per U.S. production levels) of hardwood and softwood lumber factors of 1.68 and .97 thousand board feet per metric ton, respectively, from Hayes (1990). Since wood densities can vary considerably by species, the assumed volume to weight conversion factor can significantly impact results. No additional research was performed to assess the possibility of refining the volume to weight factor as part of this analysis.

In the following sections, we provide a summary of the data sources used for dimensional wood production and consumption, as well as any data manipulations performed. We also provide a description of the method and assumptions used to estimate the amount of treated versus untreated dimensional wood produced and recent changes in the treated wood industry. Summary data and trends are presented and complete data sets for wood resource and product production are included in **Appendix A**.

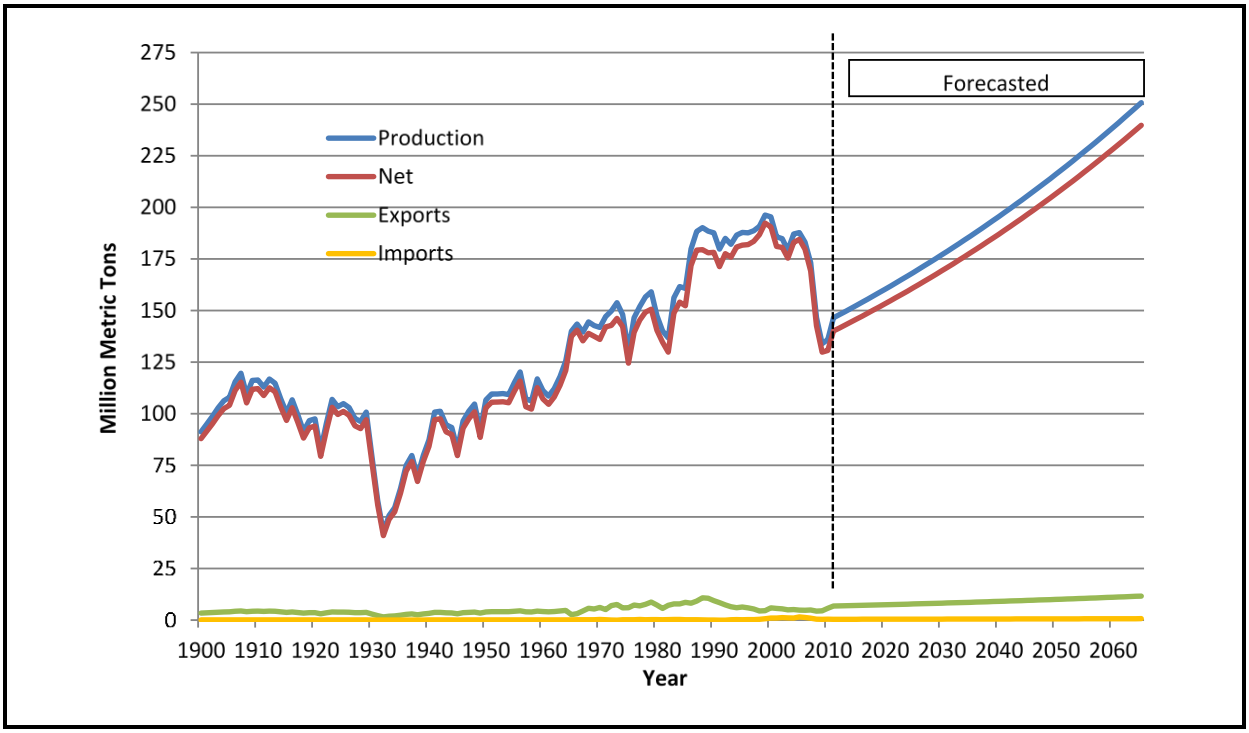
2.2.1 Dimensional Wood Production

Data for characterizing U.S. dimensional wood production are regularly updated and publicly available from the U.S. Forest Service, U.S. Census Bureau, and other public sources. Prior to the production of dimensional wood, logs are harvested from the forest resource. Data in metric tons of logs harvested, imported, and exported were located from the U.S. Geological Survey (2013). The U.S. Geological Survey data are sourced to the U.S. Forest Service

(Howard, 2013) and reported in units of metric tons, which makes them directly usable for our material flow analysis.

As shown in **Appendix Tables A-1** and **A-2** and illustrated in **Figure 2-1**, historical log production data are available dating back to 1900. However, import and export data only date back to 1965. Therefore, imports and exports were back-calculated for each year in the 1900–1965 interval using the U.S. log production levels during that period and the average ratio of imports and exports to U.S. log production levels for the period of 1965–1975 (see **Tables A-3** through **A-7** for calculated averages). The period of 1965–1975 was used as the basis for back calculating imports and exports as it provides the oldest snapshot of import/export dynamics. Overall, imports and exports of logs have been a relatively small fraction of the total wood resource used in the U.S. (**Figure 2-1**).

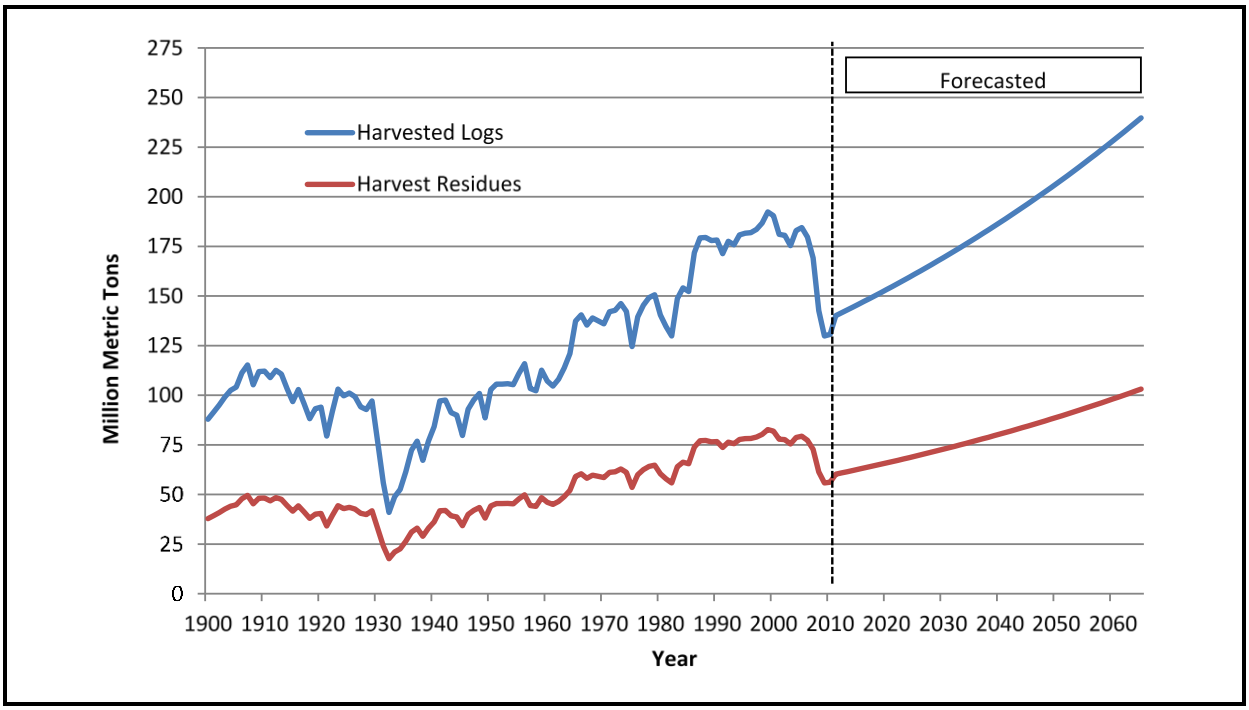
Figure 2-1. Historical and Forecasted Trends for U.S. Log Production, Imports, Exports, and Net Total Production, 1900–2065



To forecast log production data out to the year 2065, we used the U.S. Forest Service's Timber Outlook (Ince and Nepal, 2012) and applied a 1 percent annual growth rate assumption, which is the historic trend if the recessions of the 2000s were excluded. The U.S. Forest Service Timber Outlook has timber and wood product markets rebounding in future years but not reaching peak early 2005 levels until approximately the year 2050.

As part of the characterization of wood waste, we were also interested in quantifying the amount of harvest residues that are left in place when logs are produced. According to a recent U.S. Department of Energy (2011) report focused on the supply of biomass for bioenergy and bioproducts, approximately 43 percent of the biomass of a tree is left in place and unused at harvesting. This 43 percent figure was applied to the historical and forecasted logs harvest data to calculate the potential amounts of harvest residues that remain at the harvest site. For example, if 100 tons of logs are harvested then 43 tons of residues would be assumed to remain at the harvest site. The results are shown in **Figure 2-2** and should be considered rough approximations for informational purposes due to uncertainties over time as well as location and type of logs harvested.

Figure 2-2. Historical and Forecasted Trends for U.S. Logs Harvested and Harvest Residues, 1900–2065



Wood product data (U.S. production, imports, and exports) included in the U.S. Census Bureau (2015a) and U.S. Forest Service (Howard, 2013) sources include the high-level product categories of:

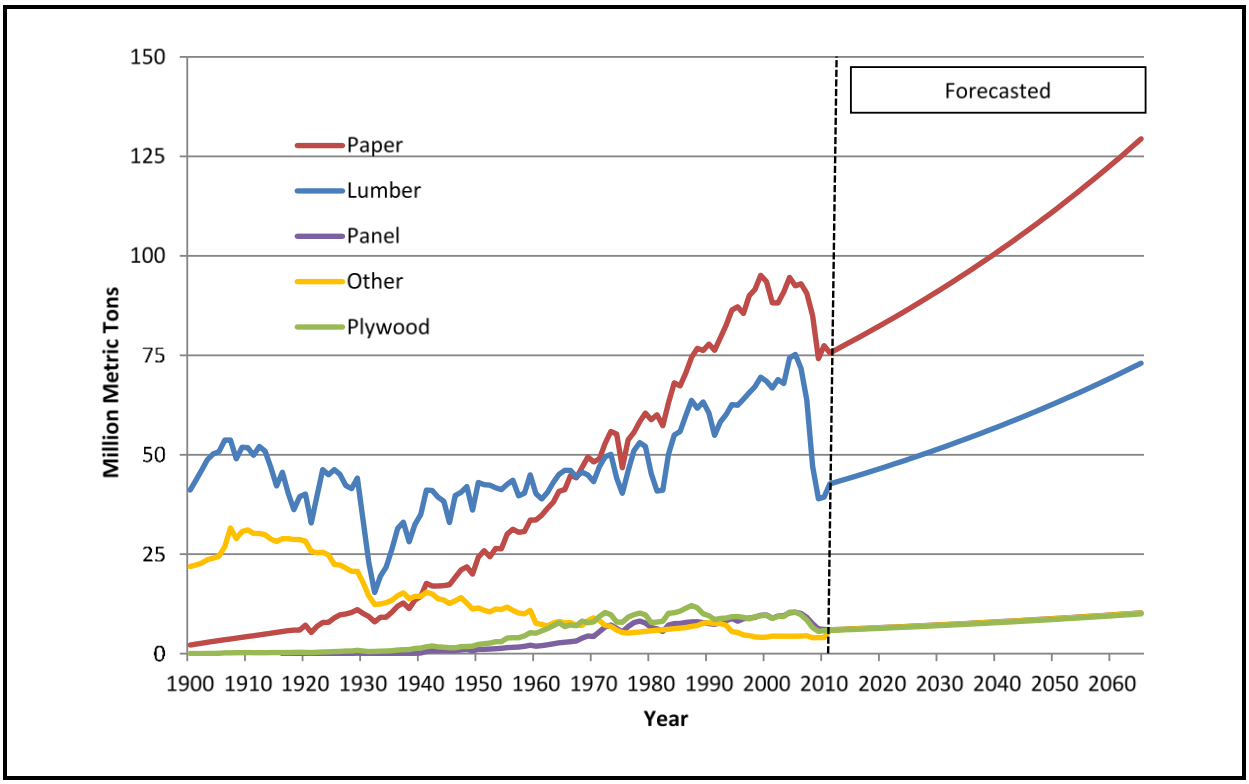
- Lumber—includes hardwood and softwood dimensional lumber and lumber used at pallet plants.
- Paper and paperboard—includes pulp, paper, and paper board.
- Plywood and veneer—includes hardwood plywood and veneer and softwood plywood.

- Wood panel products—includes hardboard, insulating board, and particle board.
- Industrial wood products—includes cooperage logs, poles and pilings, fence posts, hewn ties, round mine timbers, box bolts, excelsior bolts, chemical wood, shingle bolts, and miscellaneous items.

Data converted to metric tons of wood product produced, imported, and exported were located from the U.S. Geological Survey (2013). As with the timber harvesting data, the U.S. Geological Survey data are sourced to the U.S. Forest Service and the reported units of metric tons makes the data directly usable for our material flow analysis. We include paper and paperboard product in the wood product data to complete the picture of the flow of wood-derived materials in the U.S. economy, but the paper and paperboard category is not considered further as the focus of this study is on wood waste.

Wood product production data are available dating back to 1900. However, wood product import and export data only date back to 1965. Therefore, similar to the timber production data, we back-calculated imports and exports for each year in the 1900–1965 period using the average ratio of imports and exports to U.S. production levels for the period of 1965–1975 as it provided the oldest snapshot of import/export dynamics (**Figure 2-3**). In addition, as discussed in Section 2.4, our service-life assumptions for wood products have a maximum service-life of 70 years, which means the oldest wood product entering the waste stream today based on our model will be 1945 (2015 – 70). Therefore, to forecast the wood waste generation beyond today, we are more interested in the import/export dynamics in the mid- to late-1900s and not as much during the early 1900s.

Figure 2-3. Historical and Forecasted Trends for the Amounts of U.S. Wood-Based Product Production, 1900–2065



Again, to forecast wood product production data out to the year 2065, the U.S. Forest Service's Timber Outlook (Ince and Nepal, 2012) was to develop a 1 percent annual growth rate assumption that was applied across all wood products. Note in **Figure 2-3**, that the 1 percent annual growth rate is consistent with the historic product trends when the recession of the 2000s is excluded. The U.S. Forest Service Timber Outlook has timber and wood product markets rebounding in future years but not reaching peak early 2005 levels until the end of the forecast period for non-paper wood products. Note that in our computational model, we implemented the annual growth rate per each wood product category (rather than total wood production) so in the future we can easily adjust the growth rate assumption by product if needed. This can be relevant if, for example, the market share of a specific wood product is anticipated to significantly increase or decrease in future years.

As shown by viewing **Figures 2-1** and **2-3**, the production of wood-based products is closely linked to the production of logs. The major products as observed from **Figure 2-3** are lumber and paper products, collectively both representing roughly 90 percent of the current wood product market.

One limitation of the U.S. Forest Service data available for wood products is that they do not differentiate between treated and untreated wood products. In fact, limited statistics

were found to characterize the total amounts of treated and untreated wood products produced in the U.S. since 1900. Since different wood products have different service-lives based on the type of product and end-use application, particularly indoor versus outdoor use, it was important to understand the ratio of treated and untreated wood product produced and consumed.

2.2.2 Treated Wood

Wood products, particularly those used in outdoor applications, are susceptible to decay due to fungi and insects. Throughout history, different techniques and chemicals have been used to treat wood with the goal of preventing decay and extending its service-life. Preservative treatment is characterized in this section as the type of treatment that can affect the service life of wood used in outdoor settings as well as impact reuse and recycling of the wood at the end of its service life.

Usually the more preservative added to the wood, (i.e., higher retention level) the longer the service life. In severe wood deterioration zones, such as in the southeast U.S. and Hawaii, untreated wood left outdoors could deteriorate in as little as 1 to 3 years. Therefore, wood products designed for use in outdoor applications are often treated to ensure structural integrity for longer periods. The amounts of chemical added to the wood is a function of the desired service life for the treated wood product, and these amounts are standardized nationwide regardless of climatologic factors. While some wood species, such as southern pine, are easily treatable, most wood species do not readily accept chemical preservatives unless they are manually perforated to enhance penetration of the chemical preservative (SFPA, 2009). Due to this, approximately 85 percent of all treated wood is southern pine (SFPA, 2009).

Since 2004, the treated wood industry has been in a state of flux. During the early 2000s, the use of chromated copper arsenate (CCA) to treat wood for residential uses was phased out nationwide due to concerns about children being exposed to arsenic through playgrounds with treated wood (Consumer Products Safety Commission, 2011). Effective 2004, no more CCA was to be manufactured in the United States for products intended for residential applications (e.g., fences, picnic tables, decking, playgrounds). As a result, the residential CCA wood market was substituted with copper-based treated wood alternatives, including alkaline copper quat (ACQ), micronized copper quat (MCQ), and copper azole (CA) (Solo-Gabriele et al., 2016b). The wood waste industry is now likely observing more copper in the wood waste stream relative to arsenic, as the copper-based alternatives have more copper per mass of wood than CCA-treated wood (**Table 2-1**). The amount of copper in each of the preservatives differs except for ACQ and MCQ. The amount of copper added to ACQ and MCQ treated wood is the same; the difference is in how the copper is introduced through the preservative solution. The copper in MCQ-treated wood is added as a particle while in the ACQ solution it is dissolved. There are concerns about the toxicology of copper

when introduced as a particle instead of as a dissolved chemical. So, although ACQ and MCQ have the same formulation, we intend to estimate the amount of each type of wood within the disposal sector separately due to potential differences in the toxicity of copper contained in each.

Table 2-1. Levels of Metals in the Most Common Waterborne Wood Preservatives in Production During 2015

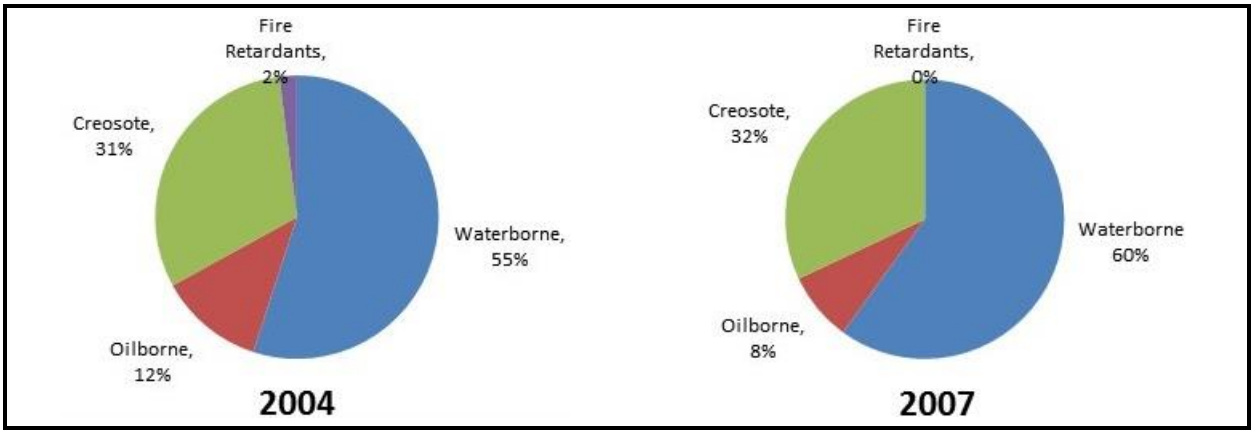
Treated Wood Type	Assumed Retention (Ground Contact) kg/m^3	mg Element per kg Wood			Allowable Percent of Treated Wood Mixed with Untreated Wood		
		As	Cr	Cu	As	Cr	Cu
Untreated		2.0	7.0	3.7	N/A	N/A	N/A
CCA, chromated copper arsenate	6.4	2,800	1,800	3,100	0.4	11	4.8
ACQ, alkaline copper quat	6.4	—	—	6,200	—	—	2.4
MCQ, micronized copper quat	6.4	—	—	6,200	—	—	2.4
CA, copper azole	3.3	—	—	4,900	—	—	3.0
Residential Guideline Levels		2.1	210	150			

N/A = not applicable

Sources: Untreated from Solo-Gabriele et al., 1998. Retention levels from AWPA, 2014. Residential guideline levels from FDEP, 2005.

Although the CCA phase-out of 2004 requires the sale of no CCA-treated wood for residential uses, there may be CCA-treated wood still being sold, presumably for non-residential uses. Waterborne preservation techniques increased following the CCA phase-out as shown in **Figure 2-4**. A study by SFPA estimated that of all waterborne wood preservatives, 29 percent still utilized CCA during 2007 (SFPA, 2009). This is down from 35 percent during 2004. The main alternative during 2004 was ACQ followed by CA. By 2007, MCQ had a greater share of the treated wood market (**Table 2-2**). According to the SFPA 2007 study, 183.2 million pounds of waterborne preservatives were used nationwide in 2004 compared to 185.2 million pounds in 2007, showing a slight increase in the total amount of chemical used during the 3-year period between 2004 and 2007.

Figure 2-4. Wood Preservation Techniques Used in 2004 and 2007



Source: SFPA, 2009

Table 2-2. Waterborne Preservative Production in the U.S. since the CCA Phase Out in 2004

	Percentage of Waterborne Market Based upon Pounds of Chemical Used for Treatment	
Waterborne Treatment Chemical	**2004**	**2007**
CCA, chromated copper arsenate	35	29
ACQ, alkaline copper quat	41	25
MCQ, micronized copper quat	Not yet commercialized	20
CA, copper azole	18	18
Other	6	8

Source: SFPA, 2009.

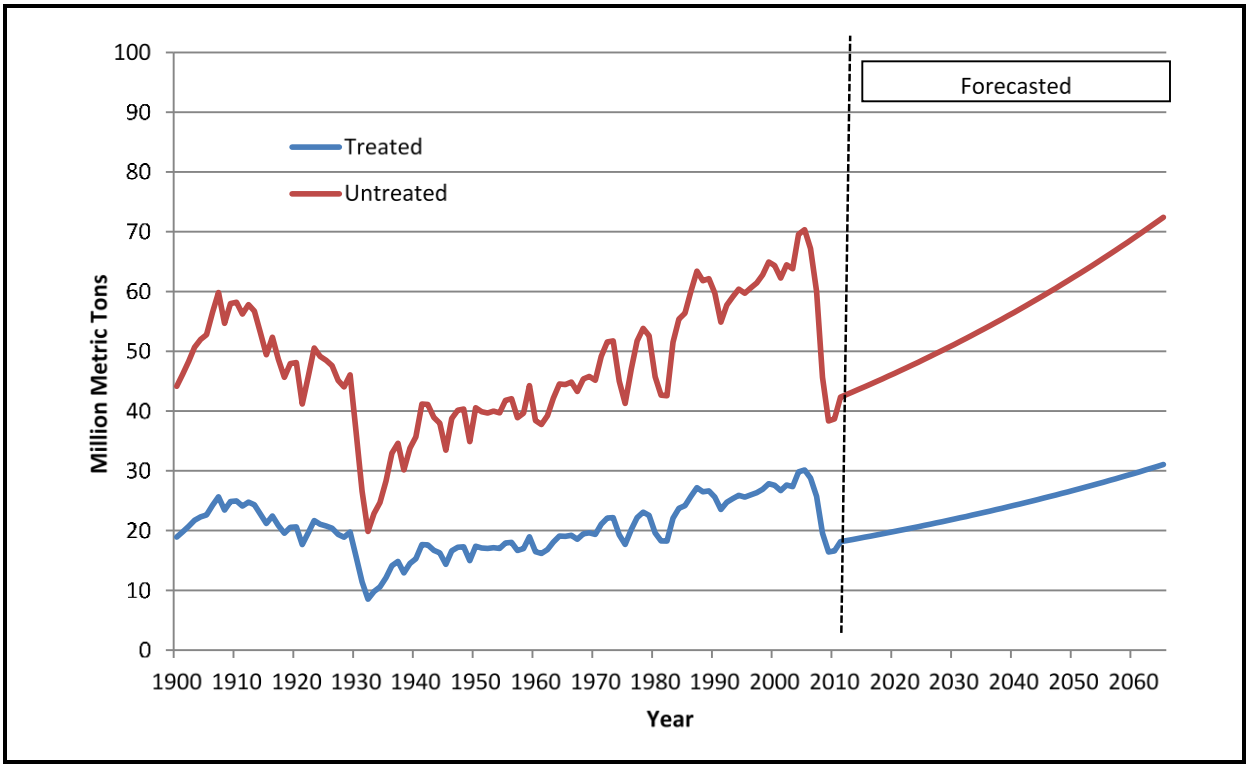
No publicly available study was found that documents the characteristics of the U.S. wood treatment industry since the SFPA (2009) study. The lack of market documentation by the wood treatment industry was attributed to the economic downturn of 2008, which significantly impacted the construction industry and consequently the wood treatment industry. As a result, funds have not been available through the wood trade organizations to document treated wood use statistics regionally and nationally (Colin McCown, Executive Vice President of the American Wood Protection Association, personal communication). Thus, industry statistics are limited after 2008.

It was learned that ACQ, as of 2015, represents a very small fraction of the wood preservative market (Kevin Archer, Director of Development for Viance, personal communication). Viance (formerly known as Chemical Specialties Inc. or CSI) held the original patent for ACQ and was the main manufacturer. As of 2015, ACQ has essentially been substituted with MCQ or with a micronized version of copper azole called micronized

copper azole (MCA). The majority of the chemical preservative market is associated with three chemical manufacturers: Viance, Lonza (formerly known as Arch Chemicals or Hickson), and Osmose. The fraction of CCA-treated wood that makes up the total waterborne wood preservative market is around 29 to 35 percent with a declining proportion in more recent years (SFPA, 2009).

Data available from SFPA (2009) were used to estimate that approximately 30 percent of the total wood product produced in the United States is treated. This percentage was applied across all study years to develop the historical statistics shown in **Figure 2-5**. Because historical statistics are not available for treated wood product production, the split can be considered highly uncertain. In addition, no data were available to characterize service life differences between CCA and newer wood preservatives.

Figure 2-5. Calculated Trends for Treated and Untreated Wood Product Production, 1900–2065



Different treated wood products receive different levels of treatment (see **Table 2-3**). For example, treated lumber used for above-ground or ground-contact applications is less saturated with treatment chemicals than utility poles. Thus, different treated wood products will have different amounts of chemical preservative and different service lives. We allocated treated wood products into three categories for application of service life

assumptions: residential, highway/marine/industrial, and utility poles. In addition, because the decay of treated wood used in outdoor applications will be significantly impacted by regional environmental conditions, the treated wood category was further allocated by region of use, with unique service life estimates. These aspects are described in Sections 2.4 and 2.5.

Table 2-3. Treated Wood by Product Type and End-Use Category Assignment

Product	Total (Board Feet)	Percent of Total Treated Wood	Use Category
Dimension lumber	4,690,278,227	36	Residential
Radius (rounded) edge heavy decking	738,667,286	6	Residential
Boards, 1-inch	498,624	0	Residential
Landscape timbers	2,902,719,816	22	Residential
Highway construction material	31,062,239	0	Highway/Marine
Glued-laminated beams	25,417,068	0	Highway/Marine
Timbers > 4x4	765,011,280	6	Highway/Marine
Pilings (foundation and marine combined)	346,520,124	3	Highway/Marine
Fence posts (4x4 and round combined)	1,659,008,196	13	Highway/Marine
Railroad crossties	622,494,072	5	Poles
Railroad switch ties	92,525,292	1	Poles
Poles (utility transmission, utility distribution, and building combined	1,089,264,360	8	Poles
Plywood (includes permanent wood foundation use) (3/8”)	77,878,155	1	Residential

Source: Total board feet from SFPA, 2009.

2.2.3 Untreated Wood

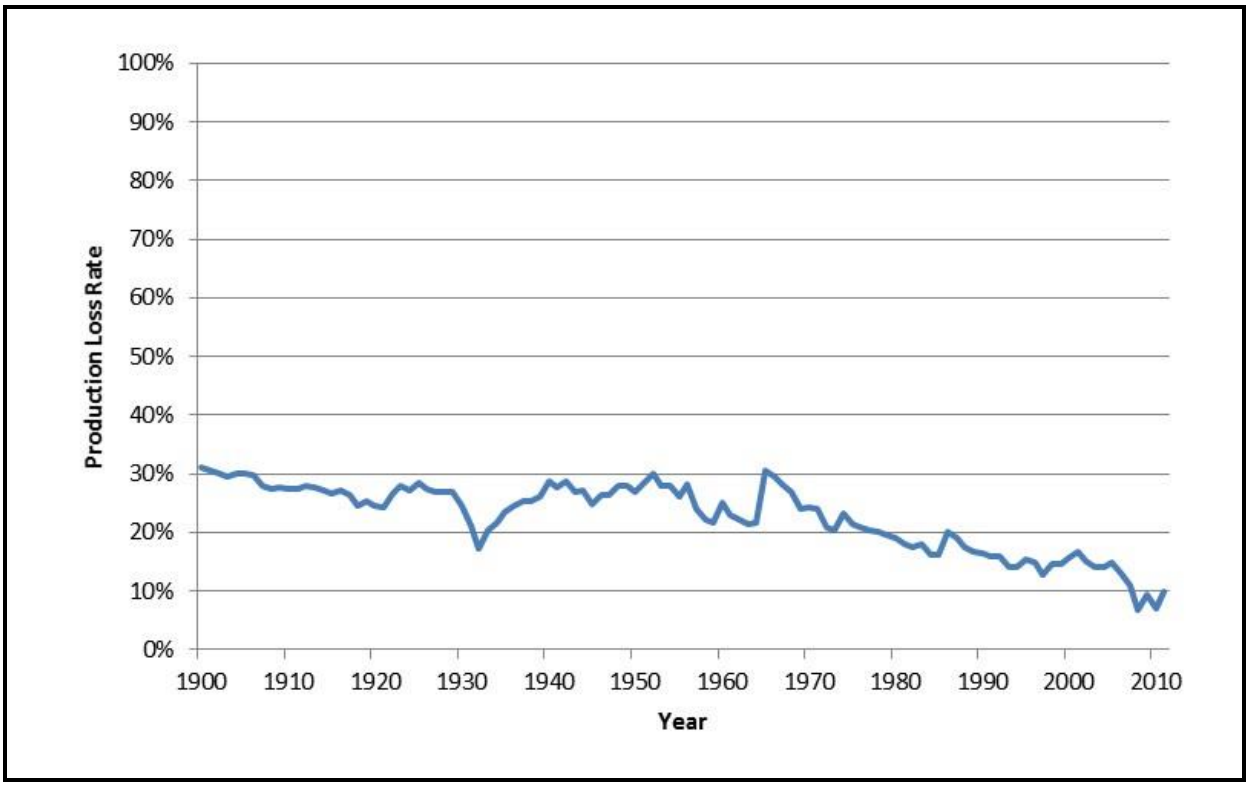
For untreated wood products, preservation chemicals and techniques are not used to enhance service life. The major trend seen for untreated wood is the change in the mix of products in the market, namely the increase in plywood and veneer since the 1950s (see **Figure 2-3**). This is directly tied to the decrease in wood product production loss rates as described in the next section. That is, the industry has gotten more efficient over time at producing valuable wood products.

2.2.4 Wood Product Production Loss Rate

In the production of wood products, we include a production loss (or residual) rate. This rate is referred to as the “productivity of industrial wood use” by the U.S. Forest Service and is calculated by the quantity (e.g., tons) of industrial wood product produced per unit (e.g.,

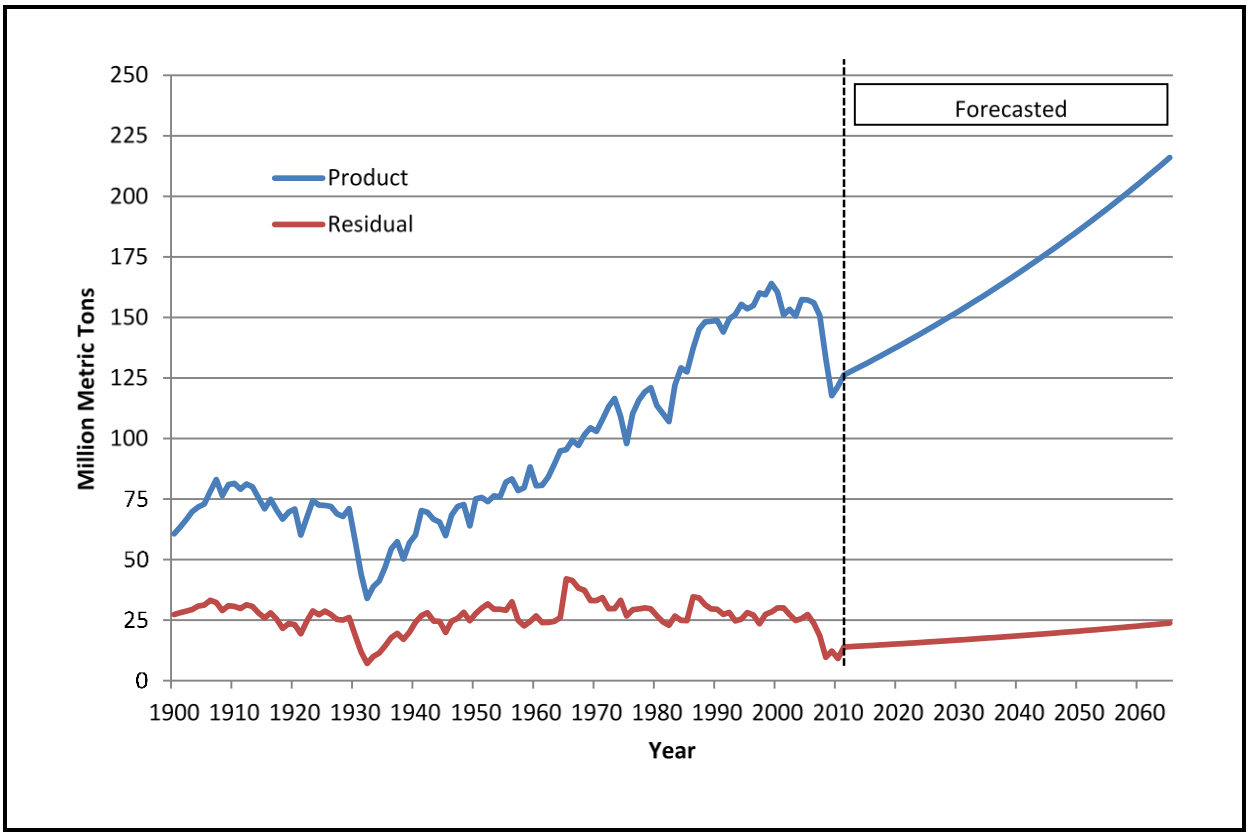
ton) of harvested log input. The historical trend from 1900 through 2011 is shown in **Figure 2-6**. The production loss rate has decreased significantly over time, which means that greater quantities of wood products are being produced per ton of timber harvested. This trend is attributed by the U.S. Forest Service to improvements in the use of wood residues and recycled wood fiber (Ince, 2000).

Figure 2-6. Historical Trend in Wood Product Production Loss Rate, 1900–2011



Residual wood from wood product production for a given year is calculated using the loss rate and is assumed to enter the waste stream. Since the loss rate was much higher in the early- to mid-1900s, ranging from roughly 20 to 30 percent, the amount of wood waste entering the waste stream from wood product production was significant. In more recent years, the production loss rate is much lower, ranging from 5 to 15 percent since 2000 for all wood products. However, since the total amount of timber input and wood product output has increased, the total amount of wood waste associated with wood product production has remained more constant as shown in **Figure 2-7**. Notable dips in the trend are seen to occur during the Great Depression in the 1930s and the global economic slowdown of the early 2000s due to drops in wood product use (and thus production levels), as well as significant reduction in the production loss rate in more recent years.

Figure 2-7. Historical and Forecasted Trends for the Total Amount of Wood Product and Residual from Production Activities, 1900–2065



To forecast residuals in future years, we assumed a 5 percent production loss rate to the year 2065. The 5 percent production loss rate is a simplifying assumption as the actual loss rate will vary through time. It should be noted that since wood product production levels are more than 100 million metric tons per year, every 1 percent change in the production loss rate can result in 1-2 million metric tons change in the amount of production residual wood waste generated.

2.3 Data for Wood Product Usage

A general assumption is employed for our model that wood product consumption in each year is equal to the wood product production (less residual wood from production losses) for the same year. The wood products industry is largely demand-driven, thus consumer demand for wood products drives production, which in turn drives timber harvesting. In our wood waste generation model (see Section 4), different service-life assumptions are used for different wood products. In this section, we describe the approach and assumptions that are employed for wood product consumption and end-use applications.

2.3.1 Treated Wood Use Categories

The design life of treated wood products is standardized by the industry at 25 years for lumber and timbers and 40 years for utility poles (Cooper, 1993; Gutzmer and Crawford, 1995). However, studies have found that the actual service life of some lumber and timber products used for residential applications—in particular, residential decks—is much shorter, ranging from 9 to 13 years (Alderman et al., 2003; McQueen and Stevens, 1998). Thus, for treated wood products, we employed three categories of product/use based on their level of treatment, which in turn dictates their service life:

- Group 1 includes wood product used for decks, fences, and landscaping.
- Group 2 includes wood product used for highway and marine uses.
- Group 3 includes wood product used for utility poles.

The main difference among these categories is the level of treatment each receives. Group 1 and 2 products receive "low-retention" treatment, whereas Group 3 products receive "high-retention" treatment, thus the service life increases from Group 1 to Group 3 (see Section 2.4 for service life assumptions).

In addition to these end-use categories, we also allocated treated wood use to U.S. regions to account for potential service-life variations due to environmental differences across the country. For example, it could be expected that treated lumber used for residential decking in Florida would have a shorter service-life than the same application in Arizona due to the higher rainfall and humidity conditions in Florida.

Data reported for the location of wood production cannot be assumed to match the location where the wood product is used. No data were found that allowed us to directly estimate treated wood consumed by state or U.S. region. Therefore, we employed U.S. regional construction-related data as a proxy for allocating treated wood use. Specifically, building permit data available for U.S. census regions from the U.S. Census Bureau (2015b) were compiled. **Figure 2-8** shows the percentage of total U.S. building permits authorized from 1959 through 2014. These data were used to create assumptions for allocating treated wood use by U.S. region as follows:

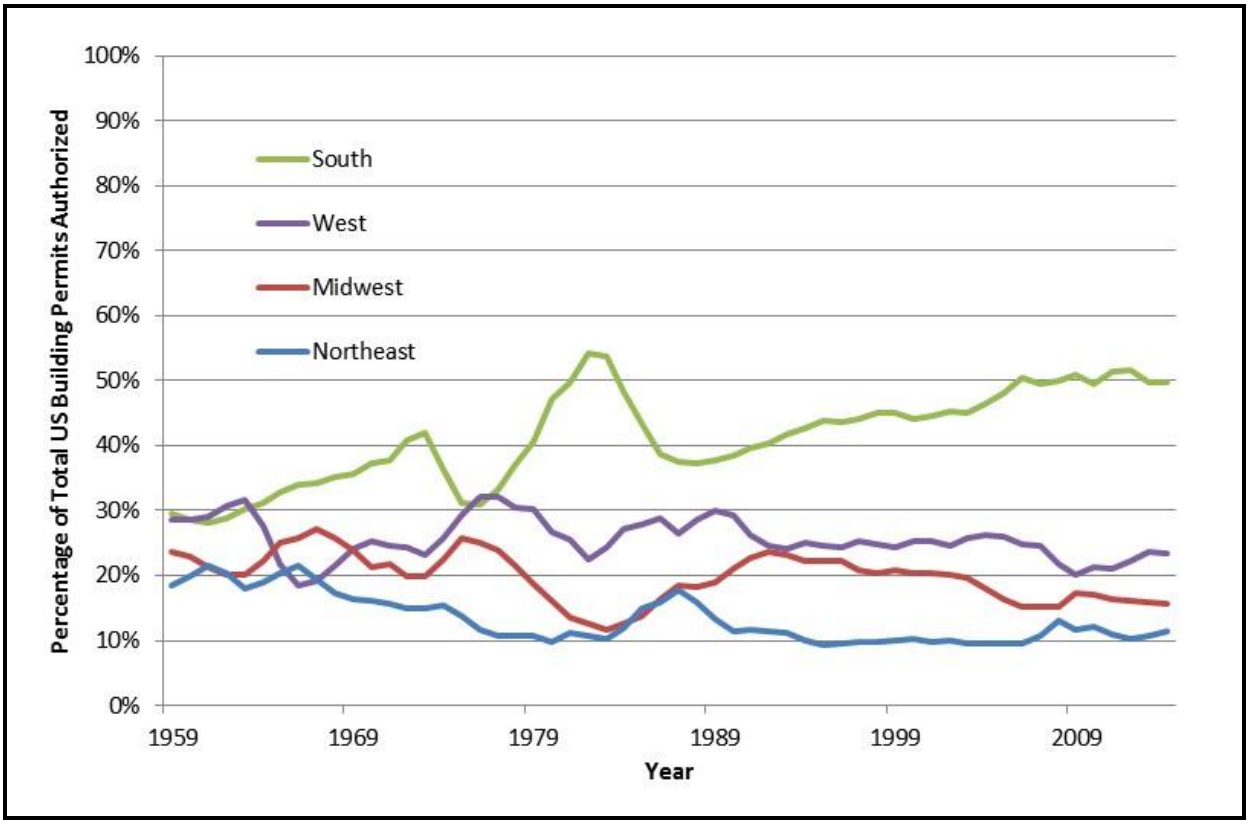
- South: 50 percent
- West: 25 percent
- Midwest: 15 percent
- Northeast: 10 percent

We did not attempt to employ regional allocations for each study year or blocks of time (e.g., 10-year averages). Such dynamic regional allocations by year could be a possible future refinement.

As an alternative to new housing permit authorizations data, we also reviewed data available for U.S. housing starts (U.S. Census Bureau, 2015c) and U.S. construction spending (U.S. Census Bureau, 2015d). The difference between housing permits and starts

is that permits represent the number of authorized permits issued for new housing units and housing starts capture the number of housing units for which construction has begun. However, as shown in **Figure 2-9**, total number of housing permits/starts and total construction spending follow a similar trend over time. With regards to construction spending, whereas housing permits and starts are for residential housing units only, construction spending captures the entire construction sector. Roads, bridges, and other

Figure 2-8. Trend of the Percentage of Total U.S. Building Permits Authorized by U.S. Census Region, 1959–2014



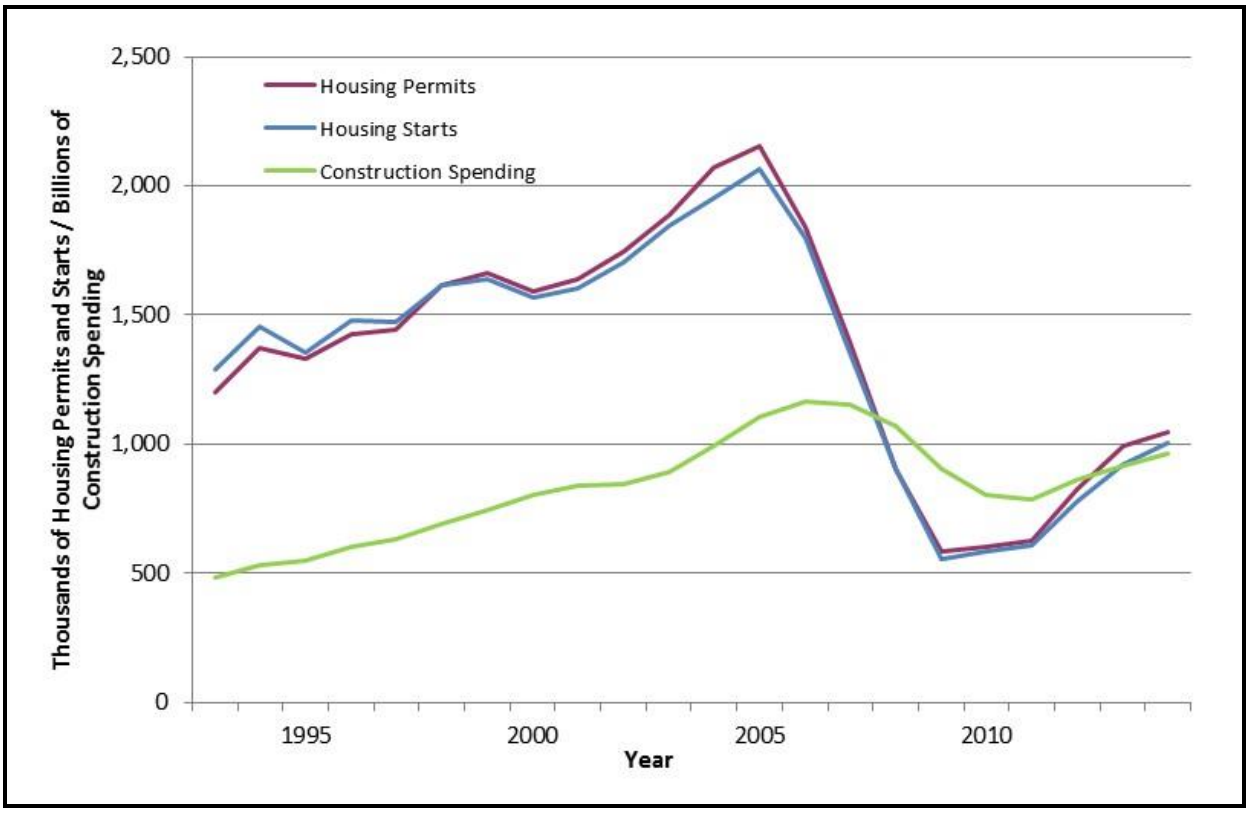
infrastructure projects are captured in the construction spending data. From the data available, we determined housing permits to be a reasonable proxy for total construction activity and in turn, wood use.

2.3.2 Untreated Wood

Untreated wood products generally are used for indoor applications and not exposed to environmental conditions (e.g., rain) that promote wood decay. The exceptions are in the treatment of wood with fire retardants and for termites. According to SPSA (2009), fire retardants represent a small fraction of treated wood (approximately 2 percent). Treatment of indoor wood for termites is generally practiced in high termite hazard zones such as

Louisiana and does not include all structures in these areas (Solo-Gabriele et al., 2016b). Therefore, different end-use categories and locations of use are not as critical as per treated wood products. However, untreated wood accounts for approximately 70 percent of the total annual wood product produced and consumed in the United States and is a significant component of the wood waste inventory.

Figure 2-9. Trends for Total Number of U.S. Housing Permits and Housing Starts (in thousands) as well as Total Construction Spending (in $billions), 1993–2014



For untreated wood, the following use categories were assumed based on the primary end-use application:

- Construction: 70 percent
- Industrial: 30 percent

2.3.3 Wood Use "Off-Cut" Rate

To account for wood waste generated during the use phase of wood products (e.g., trimming lumber to fit desired measurements), a general assumption was employed that 2.5 percent of all wood product used enters the waste stream in the same year as consumption due to off-cut based on Cooper (1993). The off-cut assumption is likely not

static through time, however time-series data were not found to allow for further refinement. It should be noted that since wood consumption levels are more than 100 million metric tons per year, every 1 percent change in the consumption off-cut assumption can result in 1-2 million metric ton change in the amount of residual wood waste generated.

2.4 Wood Product Service Life Assumptions

The service life of wood products is defined as the period after installation or use during which the products meet or exceed the performance requirements (Viitanen et al., 2010). The following sections focus on estimating service lives for treated and untreated wood products. Adjustments are provided to allow for the variation in service life based upon climatologic differences across the United States.

2.4.1 Service Life Assumptions for Treated Wood Products

Various studies have placed numerical values on the standardized service life of treated wood products. For lumber and timber, products treated at low retention levels are considered to have a service life of 25 years on average, whereas for pilings, which are treated to higher retention levels, the service life is generally considered 40 years on average (Cooper, 1993; Gutzmer and Crawford, 1995; Solo-Gabriele and Townsend, 1999). For lumber and timber products used in residential applications such as decks and fencing, the "actual" service life may be less than the service life projected based upon structural integrity because owners may remove the wooden structures earlier for aesthetic reasons (e.g., weathering of the wood or paint, splintering). As a result, treated lumber and timber products used for residential purposes have a shorter service life relative to their design service life. Studies by McQueen and Stevens (1998) and Alderman et al. (2003) found that the "actual" in-service life of low retention CCA-treated wood products used in residential applications varies from 9 to 13 years on average.

Not all lumber and timber is used for residential applications. A large fraction is used for highway and transportation needs (estimated at 40% of the total lumber and timbers by Khan et al. 2006). For these uses, evidence suggests that the wood may remain in service throughout the time the structural integrity remains intact. The prolonged service life for highway uses of treated wood is supported by studies that show that the structural integrity of wood used as guardrail posts remains intact even after a service period of over 20 years in Bellingham, Washington (Love et al., 2014).

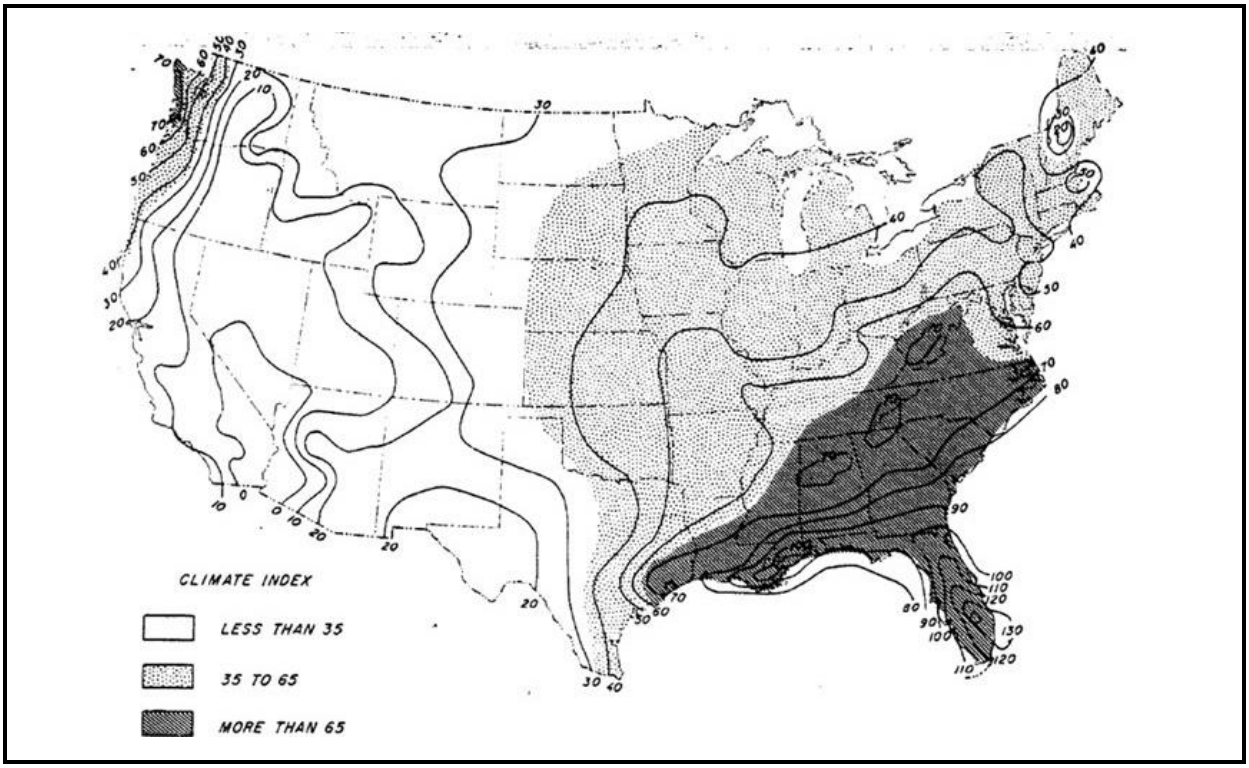
Poles and pilings represent the third category of treated wood products evaluated in this study. Recent confirmatory research has shown that the service lives of poles and pilings is long, on the order of 40 years (Bolin and Smith, 2012) with some poles remaining intact for many more years (Wakeling and Morris, 2014). Service life estimates employed in this study for treated wood products are as listed in **Table 2-4**.

Table 2-4. Base Service Life Assumptions Used for Treated Wood Products

Product	Average Service Life (years)
Lumber and timbers used for residential applications	10
Lumber and timbers used for highway, commercial, and industrial applications	25
Poles and piles	40

Among factors that influence the service life of wood, all studies evaluated acknowledge moisture as the primary key component. Other factors include rainfall intensity (Lebow et al., 2013), soil substrate (Brischke and Olberding, 2014; Brischke and Thelandersson, 2014; Lebow et al., 2013), coatings and end-grain protection (Jermer, 2012), wood species (Wanget al., 2008), and specific use of the wood (Grant and Reis, 2013). The most widely used index of wood decay observed in the literature is the Scheffer index (Scheffer, 1971). This index sets a climate index for wood deterioration based upon mean monthly temperature and monthly precipitation. The values of this index have been computed nationwide and vary from 0, suggesting minimal decay risk, to 100, indicating severe decay risk (**Figure 2-10**).

Figure 2-100. Scheffer Climate Index Map Based Upon Monthly Precipitation and Mean Temperatures



Source: Scheffer, 1971.

The standard method to assess the service life of wood products is through a series of stake tests (1.5 in. x 3.5 in. x 18 in.) in which wood samples are placed in the ground over periods of many years. Different plots of land are dedicated to stake tests throughout the country to evaluate the influence of climate and soil conditions on deterioration rates. Results from stake tests are available for untreated wood in various states including Mississippi (2.9 years to failure) and Wisconsin (5.7 years to failure) (Woodward et al., 2011).

Using this information, the Scheffer index for these locations was used to estimate relative service lives based upon the differences in climatologic conditions between these two regions. The Scheffer index for Mississippi is 99 and for Wisconsin 39. Using a value of 50 as an average value, the service lives can be adjusted according to a service life adjustment factor. The service life adjustment factor, which is determined by interpolation, can be used to multiply the average service life for the product to estimate the service life of wood products within a given climate zone (**Table 2-5**). Within each climate zone the Scheffer index can vary considerably. Rough representative approximations were made and used to compute the service life adjustment factors for the region. Service life adjustment factors were estimated for the four U.S. regions used for modeling purposes and vary from 0.6 for the South, the most severe deterioration zone, to 1.2 for the West and Midwest, which correspond to low deterioration potentials.

Table 2-5. Service Life Adjustment Factors for U.S. Climate Zones

	Assumed Scheffer Index	Service Life Adjustment Factor
South	100	0.6
West	25*	1.2
Midwest	25	1.2
Northeast	50	1

Note: The Scheffer index varies considerably in the west with high values in northwest Washington State.

Using the service life adjustment factors listed in Table 2-5, the base treated wood service life estimates were adjusted as shown in **Table 2-6**.

2.4.2 Service Life Assumptions for Untreated Wood Products

For untreated wood product use categories—construction and industrial—different service life estimates are applied. Untreated wood used in construction typically is utilized indoors and its service life is dependent upon the rate at which buildings are renovated or demolished. Models vary considerably with respect to service life assumptions for buildings. For example, service life estimates for residential buildings varied from 60 to 100 years depending upon the model used (Grant and Ries, 2013).

Table 2-6. Adjusted Service Live (Years) Estimates for Treated Wood Products

Product	Base Service Life	*Adjusted* Service Life			
		South	Midwest	West	Northeast
Lumber and timbers used for residential applications	10	6	12	12	10
Lumber and timber used for Highway, commercial, and industrial applications	25	15	30	30	25
Poles and piles	40	24	48	48	40

Within industrial applications, wood components may have variable service lives. The U.S. Army Corps of Engineers, in its building service life models, uses a 28-year replacement period for roofs and 125-year replacement period for siding (Neely et al., 1991). To account for renovation building service Bergsdal et al. (2007), in their building service life models, assume two renovation cycles and one demolition cycle. For small buildings, the first renovation is modeled to occur at 30 years, the second renovation at 60 years, and demolition at 90 years. For large buildings, this same study assumed 20, 40, and 60 years for the first and second renovation, and demolition, respectively.

Based on the literature, best-estimates for untreated wood service life averages were developed for use in the inventory model and are listed in **Table 2-7**.

Table 2-7. Service Life Values Used for Untreated Wood in Residential and Industrial Settings

Setting	Estimated Average Service Life (years)
Residential applications	70
Industrial applications	50

Unlike treated wood products, for untreated wood products, regional usage patterns were not discerned for the purposes of making service life assumptions. Because untreated wood is primarily used in indoor applications, this factor is not expected to play a significant role. However, the same regional allocation of consumption used for treated wood and described in Section 2.3 was also applied to untreated wood. The value in applying the same regional allocation may be to develop regional estimates for total (treated and untreated) wood waste generation and wood remaining in service. In addition, the regional allocation for

untreated wood will enable possible future region-based adjustment to service life assumptions for untreated wood.

3. ESTIMATED AMOUNTS OF WOOD WASTE GENERATED AND WOOD REMAINING IN SERVICE

To estimate the amounts of wood waste generated and the amounts of wood remaining in service, the computational methodology for the materials flow approach was implemented using R, an open-source statistical computing software. The conceptual framework for the R model is shown in **Figure 3-1**. The computational methodology implements the "upstream" timber and wood product data and assumptions, such as the production and installation losses, and the service life assumptions to calculate the portion of various wood product that enter the U.S. waste stream and remain in service.

In this section of the report, we present the summary results from the computational model for wood waste generation and wood that remains in service for our study period of 1900–2065. Detailed results tables are included in **Appendix B**.

3.1 Wood Waste Generation

Based on our wood waste inventory model, the amount of wood waste generated in any given year is a function of the following elements:

- Amount of harvest residual
- Amount of offcut generated during wood product installation in the given year
- Amount of residual wood generated annually in wood product production and use activities
- Amount of wood that reaches the end of its useful life and enters the waste stream based on the useful service life (lifespan) of various wood products in various regions of the United States and various end-use applications.

Figure 3-2 illustrates the total amount of wood waste (treated and untreated) generated on an annual basis for our study period of 1900–2065. Note that because different wood products have different service lives, not all the wood produced and consumed in 1900 will enter the waste stream at the same time. It is not until 1970 that some of the wood products that were produced and consumed in 1900 will be entering the waste stream. Thus, as illustrated in **Figure 3-2**, a "ramp up" effect is portrayed in the data. In addition, as our most recent year for wood product production and consumption data is 2011, yet our study period extends out to 2065, there is also a "ramp down" effect. The ramp down effect was addressed by estimating wood product production levels out to the year 2065 based on economic forecasts, which are strongly correlated with construction activity and thus wood use.

Figure 3-1. Conceptual Diagram of the Wood Waste Inventory Computation R-Model

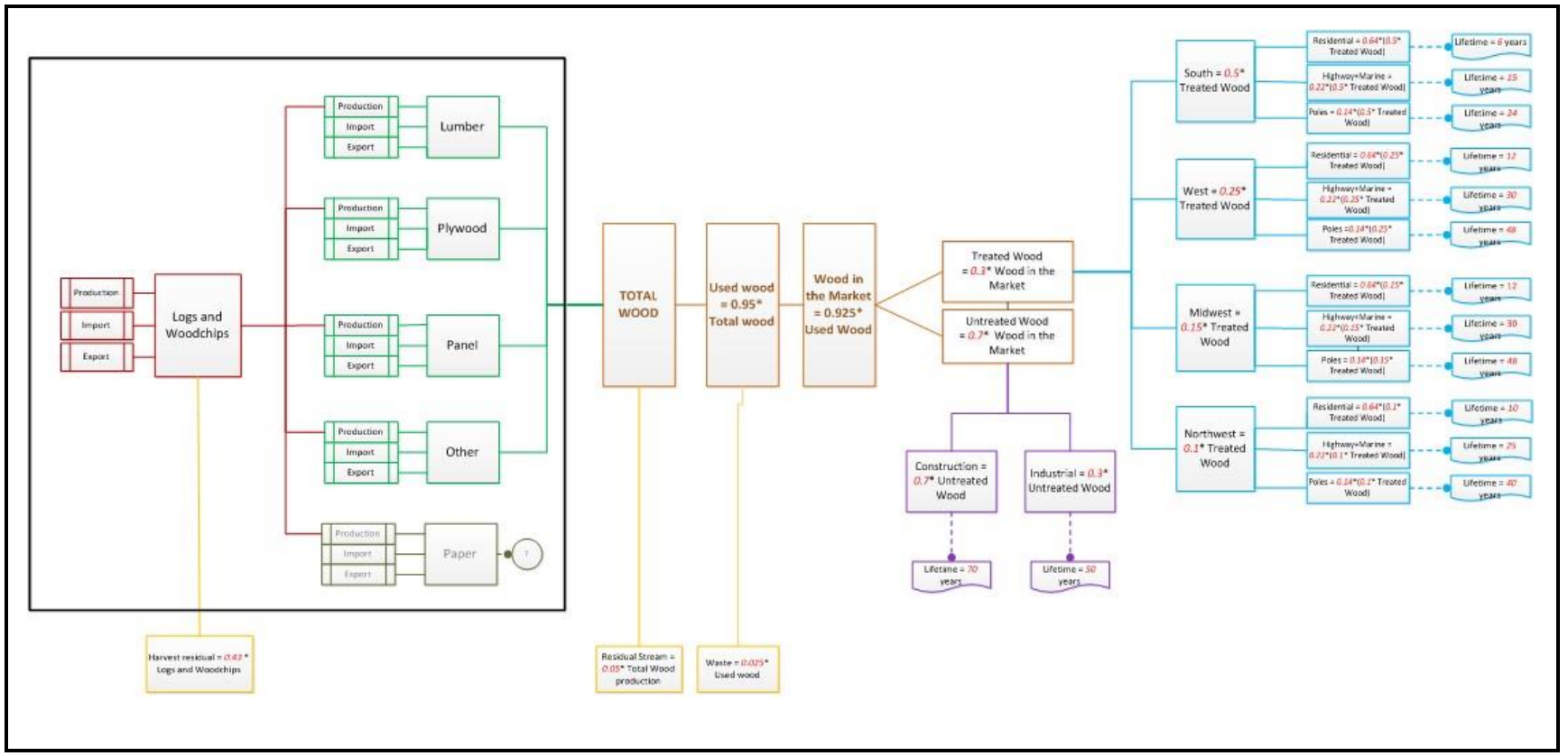
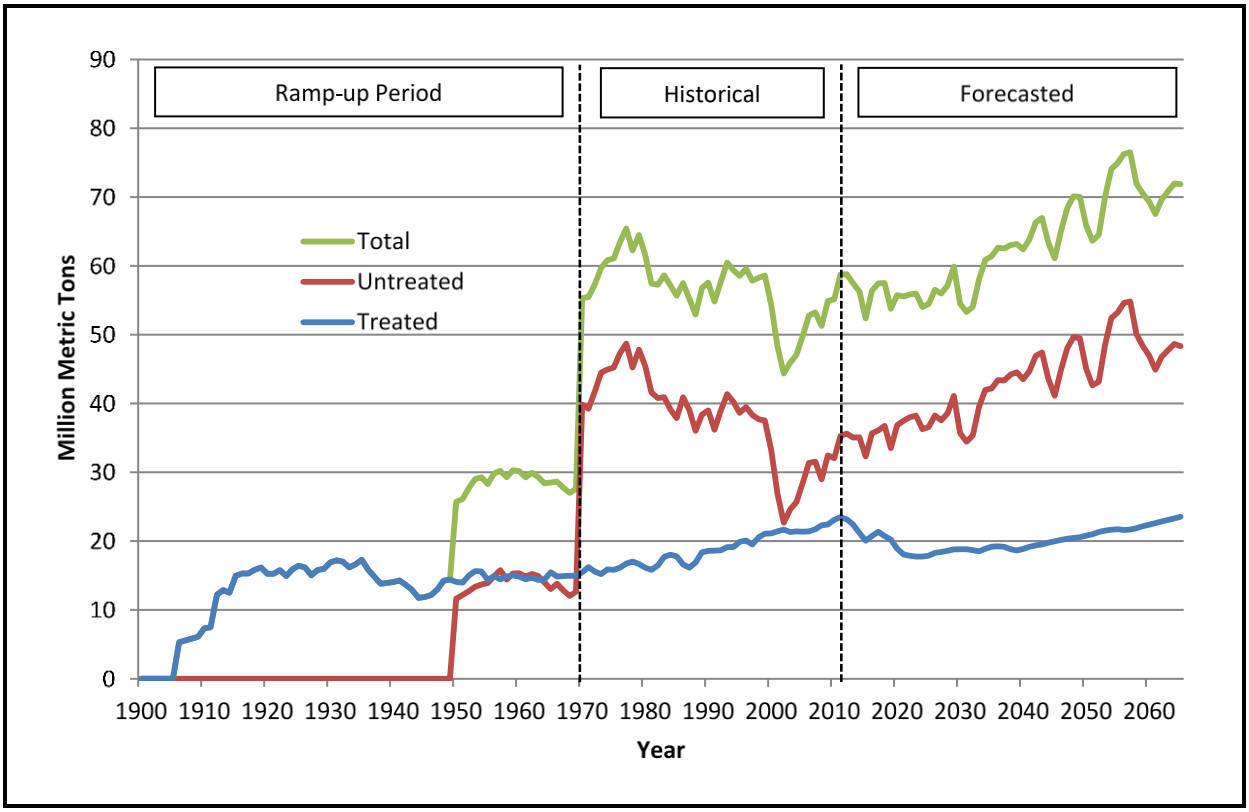


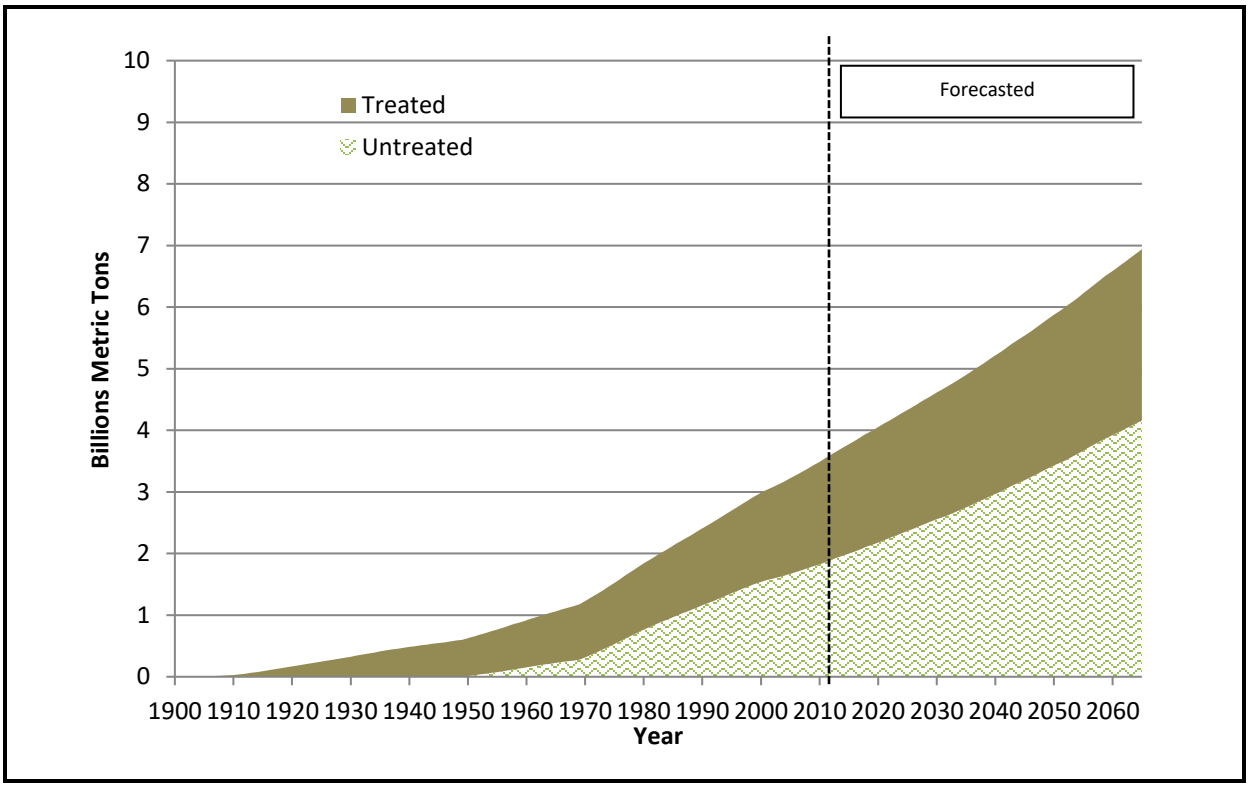
Figure 3-2. Annual Generation of Treated, Untreated and Total Wood Waste, 1900–2065



The portion of **Figure 3-2** labeled "historical" contains estimated generation quantities based on historical data for wood production and consumption whereas the portion labeled "forecasted" represents estimated generation quantities based on wood production and consumption projections. It is interesting to note that the projected generation of untreated wood waste will outpace treated wood waste in future years. That is, treated wood waste generation grows more slowly over time (shallower trend line) than untreated wood waste. By 2050, the amount of untreated wood waste generated is estimated to be more than double the amount of treated wood waste.

In **Figure 3-3**, we illustrate the cumulative amount of treated, untreated, and total wood waste that has entered the waste stream since 1900 and projected out to 2065. By 2065, there will be approximately 7 billion metric tons of wood waste generated since 1900. Much of this wood has likely been deposited in dumpsites and engineered landfills over time. However, due to relatively long service lives of many wood products, most (approximately 70 percent) of the wood produced and consumed in 1900 did not enter the waste stream until after 1970 and thus was more likely deposited in engineered landfills.

Figure 3-3. Cumulative Generation of Treated and Untreated Wood Waste, 1900–2065



Figures 3-4 and **3-5** show the amounts of treated and untreated wood waste generated by U.S. Census region (which includes South, West, Midwest and Northeast regions) produced by the model. As shown in **Figure 3-4**, the amount of treated wood generated by the South region is significantly greater than other regions. There are two reasons for this. First, the South region was estimated to consume approximately half of all wood produced (see Section 2.3), thus it is expected that it would have greater amounts of wood waste generated. Second, and specific to treated wood, is that the South region's warm and wet climate enhances wood degradation and thus the service life for treated wood is shorter than for other regions. This means more treated wood waste is generated in the South per unit of consumption.

In **Figure 3-5**, the amounts of untreated wood waste generated track directly with the amounts consumed by region as regional service life adjustment factors were not implemented. Because untreated wood is typically used in indoor applications and not exposed to weather, the region of use is not expected to impact its service life. If, however, regional service life adjustments are determined, they could easily be implemented to better approximate regional amounts of untreated wood waste generated.

Figure 3-4. Treated Wood Waste Generated by U.S. Region, 1900–2065

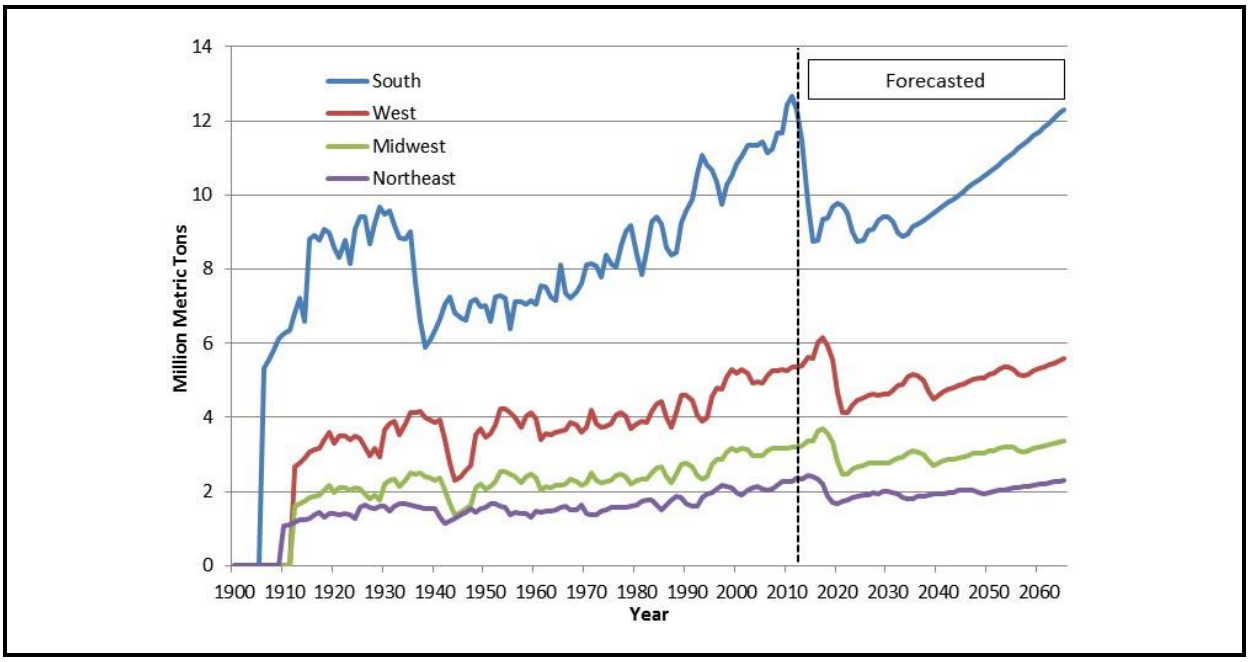
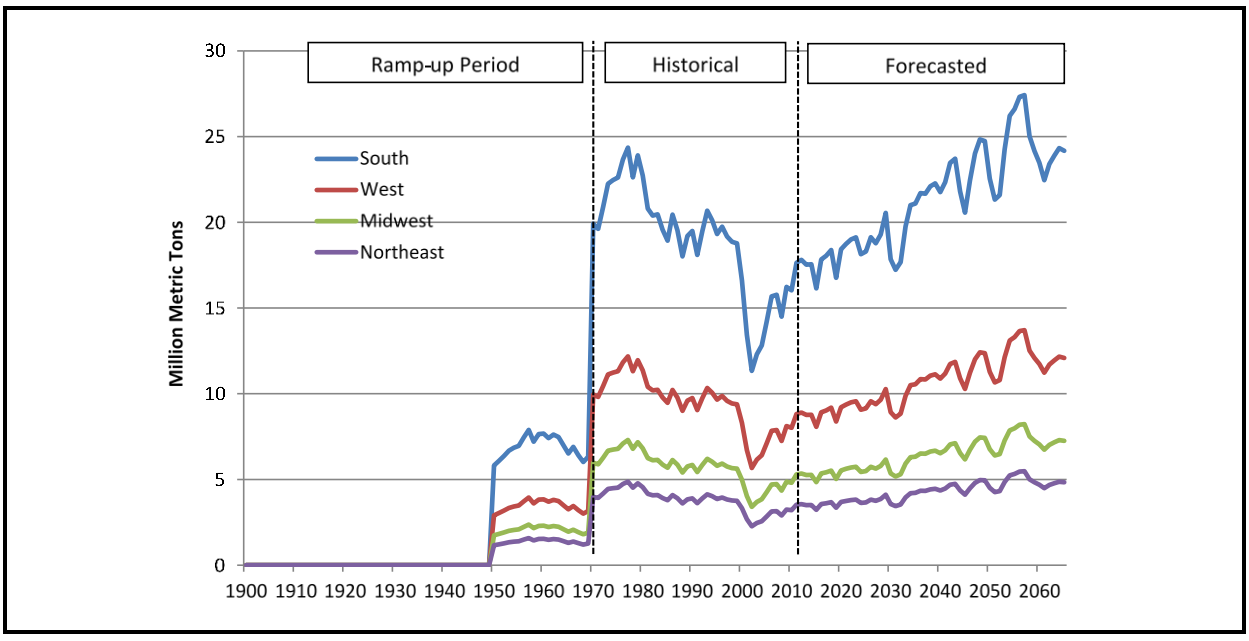


Figure 3-5. Untreated Wood Waste Generated by U.S. Region, 1900–2065



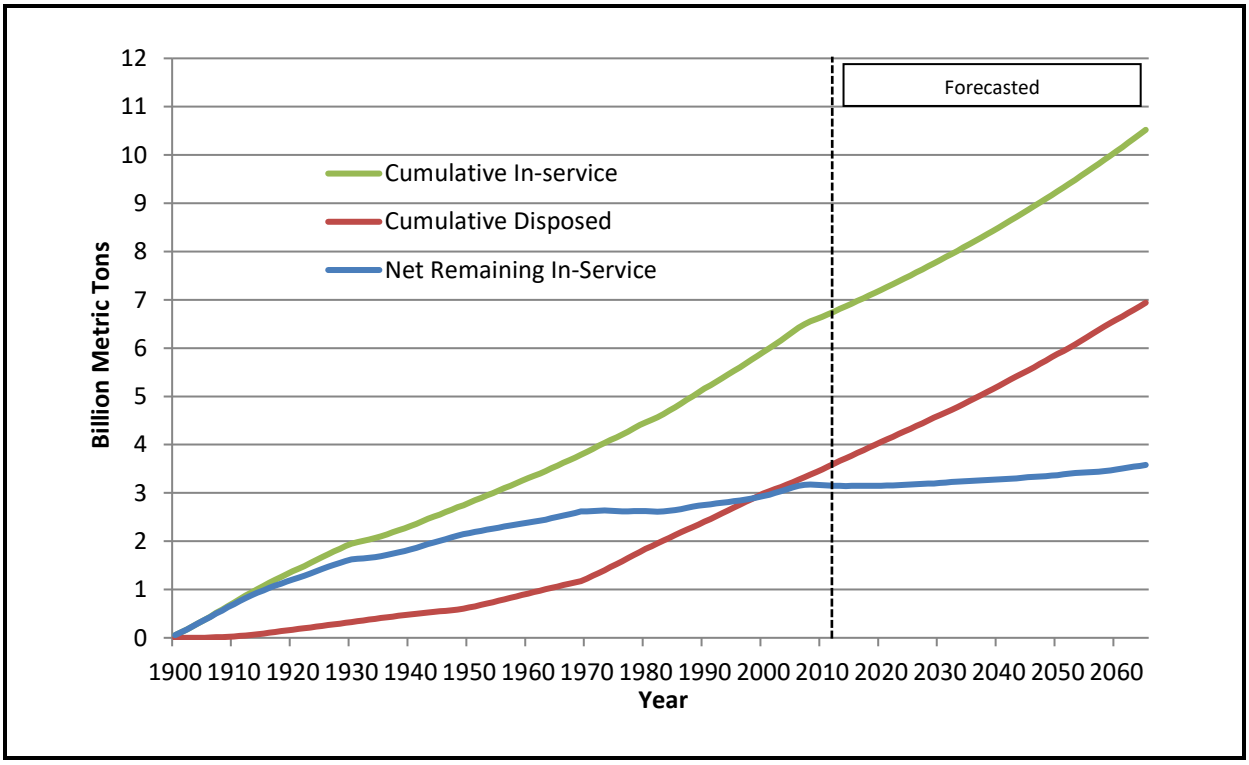
It is clear from **Figures 3-4** and **3-5** that most wood waste generated occurs and will in the future occur in the South and West regions of the United States. This information can be useful for planning infrastructure and management policies and schemes for wood waste.

3.2 Wood Remaining In Service

As expressed by Equation 2-1, the amount of wood that remains in service in each year is calculated as the amount of wood product consumed in that year less the amount of wood entering the waste stream in the same year from production/consumption residues and previous year wood consumed that has reached the end of its service life (which varies by wood product and location of use). Thus, the amount of wood that remains in service is ultimately governed by the useful life of wood products.

The estimated cumulative amounts of treated, untreated, and total wood that remain in service (i.e., in buildings and wood structures) is shown in **Figure 3-6**. In 2011, an estimated 3.18 billion metric tons of wood remain in service. By the year 2065, this amount is anticipated to increase to 3.58 billion metric tons. It is interesting to note in **Figure 3-6** that the cumulative amounts of wood generated and remaining in service follow a similar linear trend. Thus, the net amount of wood remaining in service is relatively flat over time, but does increase slightly.

Figure 3-6. Cumulative Amounts of Wood In Service and Wood Waste Generated, and Net Cumulative Amount of Wood Remaining In Service, 1900–2065



In **Figure 3-7**, the cumulative amounts of treated and untreated wood remaining in service are shown. This chart illustrates the impact that the longer service life of untreated wood

product (as compared to treated wood) has on the total amount of wood remaining in service. The shorter service life of treated wood product leads to treated wood going in and out of service more quickly and a stabilization/steady-state of the amount of treated wood that remains in service over time. Much larger amounts of untreated wood remain in service due to both the longer service life of untreated wood as well as the significantly larger share of untreated (70 percent) as compared to treated (30 percent) wood produced and consumed in the United States.

Figure 3-7. Cumulative Amounts of Treated, Untreated, and Total Wood Remaining In Service, 1900–2065

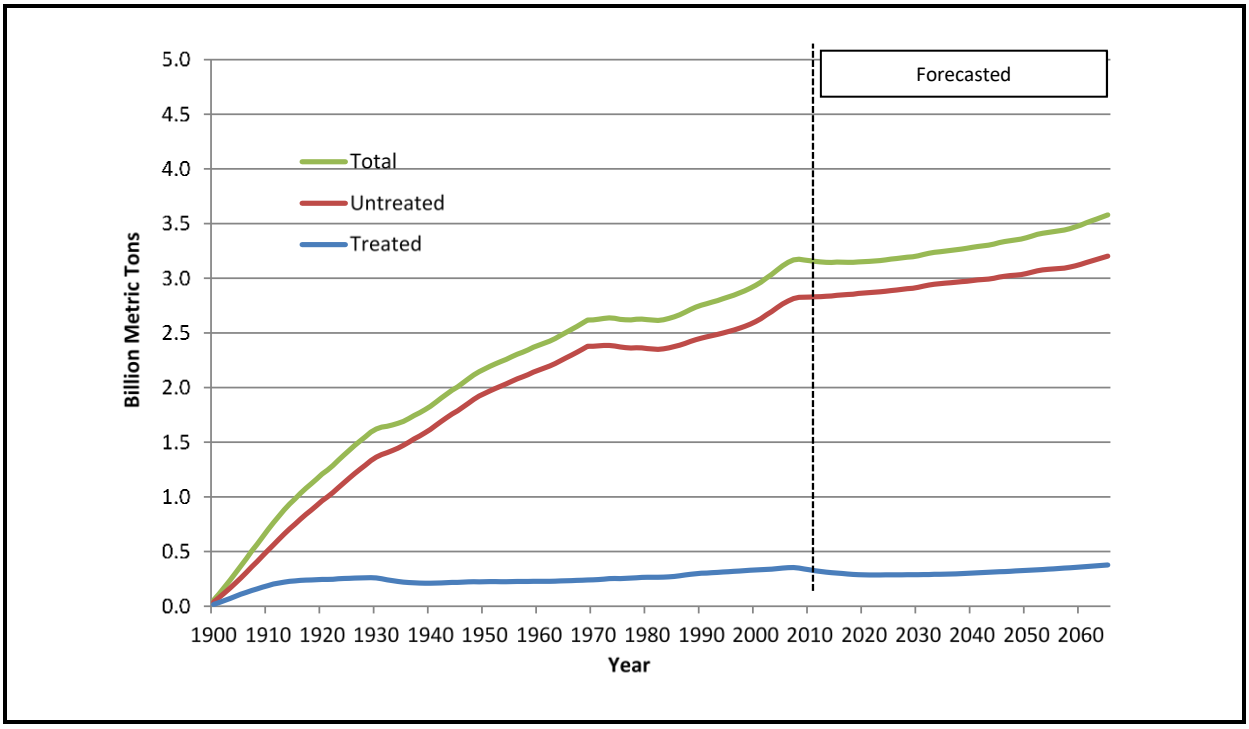
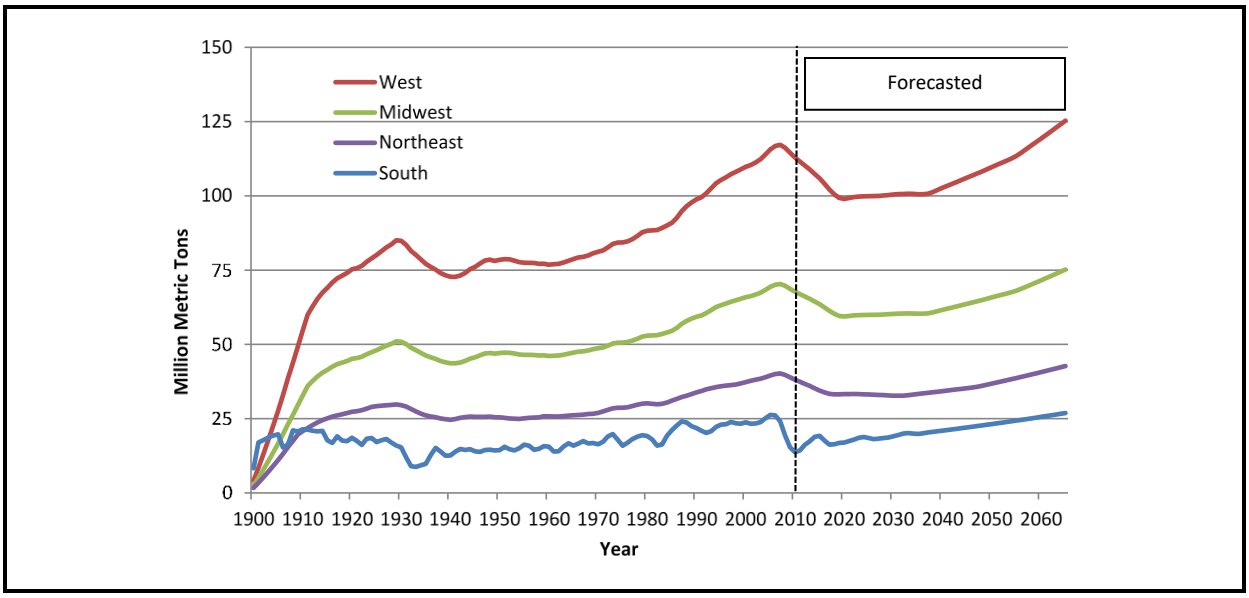


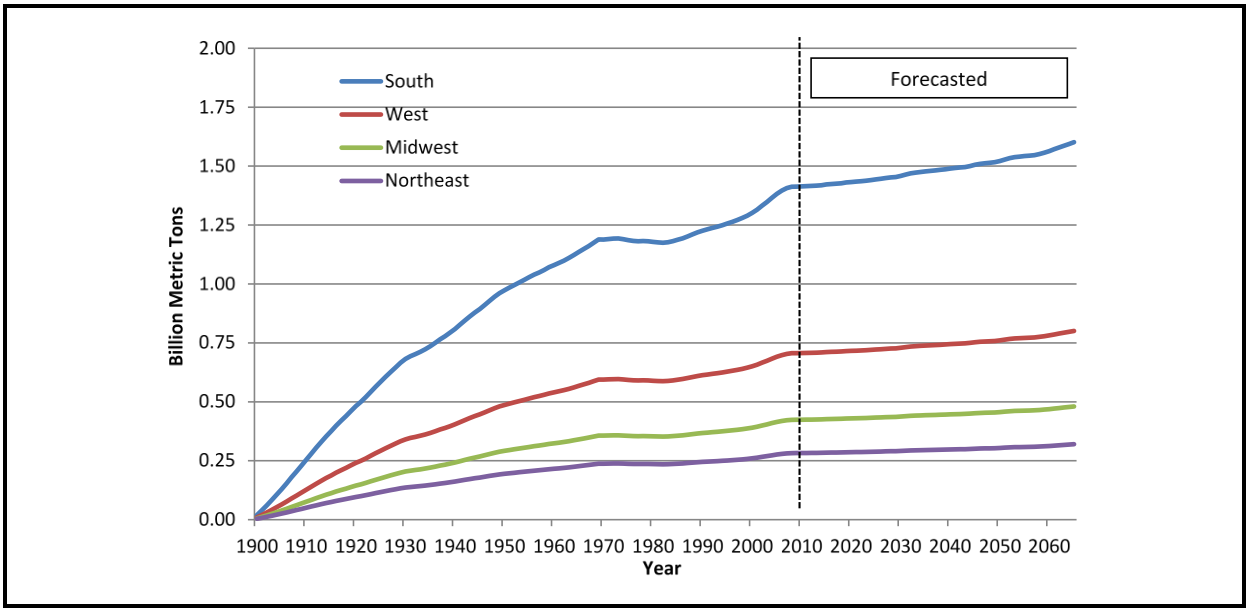
Figure 3-8 shows the cumulative amounts of treated wood remaining in service by U.S. region. It is interesting to note that while the South consumes 50 percent of the treated wood, it has the lowest cumulative amount of treated wood remaining in service due to the shorter service life in this region. Thus, treated wood in the South moves in and out of service relatively quickly, creating a lower stock of wood remaining in service. In contrast, the West has a longer service life and more treated wood accumulates in service over time.

Figure 3-8. Cumulative Amounts of Treated Wood In Service by U.S. Region, 1900-2065



Opposite of the results for regional wood remaining in service, **Figure 3-9** shows that for untreated wood, the cumulative amounts remaining in service are directly linked to consumption levels. Thus, as expected, the South and West regions contain most wood in service over time.

Figure 3-9. Cumulative Amounts of Untreated Wood In Service by U.S. Region, 1900–2065



3.3 Other Sources of Wood Waste

In addition to wood product waste entering the waste stream at the end of its service life, wood and woody biomass waste are generated from other sources including catastrophic events (e.g., hurricanes, floods, fires), invasive species, diseases, and as part of general municipal solid waste (MSW).

In this section, we summarize our approach and data for estimating the tonnage of wood and woody biomass generated from these other sources and use this information to supplement the wood waste generation from our inventory model. Other potential factors influencing the amount of wood waste generated might include invasive species and diseases. However, data to characterize such impacts at the national level were not found.

3.3.1 Catastrophic Events

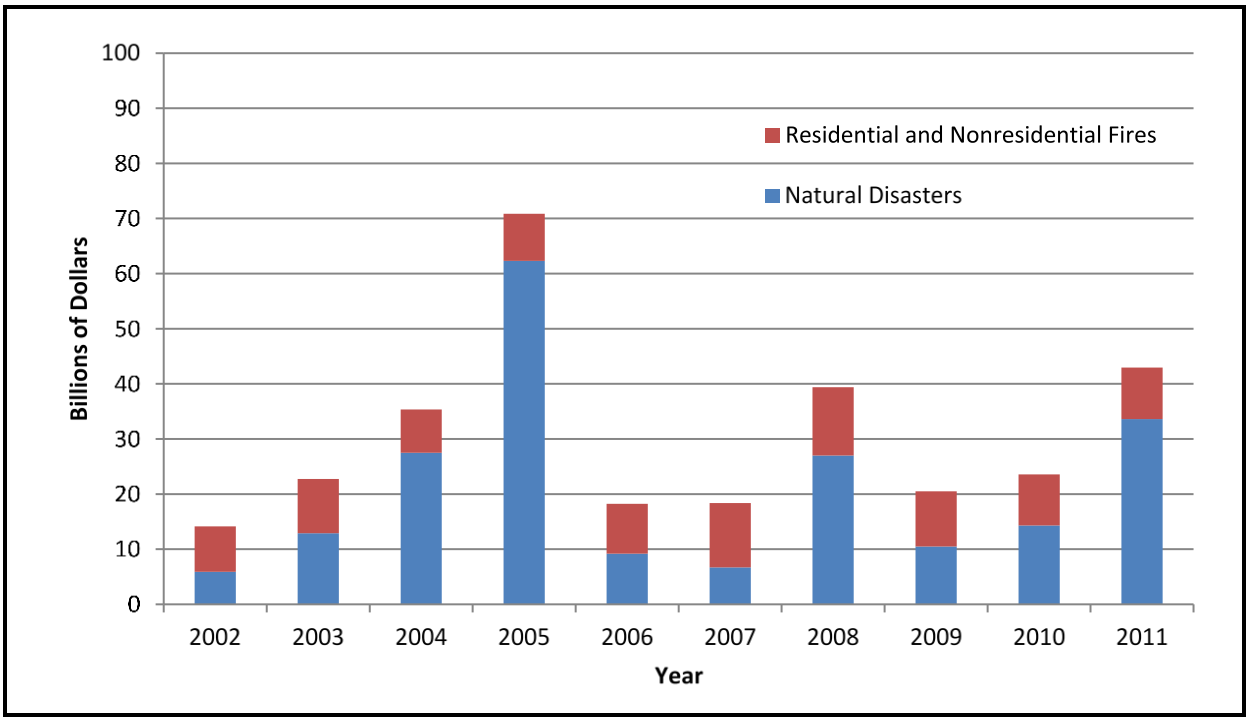
In addition to residual wood from production and use activities, and wood entering the waste stream at the end of its service life, wood waste is also generated because of catastrophic events, such as hurricanes, floods and fires. We attempted to characterize the amount of "catastrophic wood loss" on an annual basis to supplement the conventional end-of-life pathways (i.e., production and use phase residual streams and end of service life). The primary routes of catastrophic wood loss, C_i, during year i, are assumed to be hurricanes/floods, $C_{i,h}$, and fires $C_{i,f}$, such that:

$$C_i = C_{i,h} \_ + C_{i,f} \quad \text{(Equation 3-1)}$$

Data are readily available that characterize the number and estimated dollar-value of loss associated with natural disasters and fires. However, data characterizing the volume or tonnage of total disaster debris, and especially the wood component, are much more limited. Our approach for estimating catastrophic wood loss was to correlate dollar-value of loss statistics with tonnage of wood waste.

Data from the Insurance Information Institute (2015) and the Federal Emergency Management Agency (FEMA, 2015) were used to characterize dollar-value of loss associated with natural disasters and fires, respectively. These data were used to calculate a 10-year (2002–2011) average dollar-value of losses of approximately $21 billion per year for natural disasters and $9.6 billion per year for fires (**Figure 3-10**). Note that for fire data, 80 percent of the total dollar-value of loss was taken to account for vehicle fires and other fires included in the data. Combining the natural disaster fire data (III 2015 & FEMA 2015), the calculated total 10-year average dollar-value of loss is estimated at roughly $30.6 billion per year.

Figure 3-10. Dollar-Value Loss Associated with Natural Disasters and Fires, 2002–2011



Sources: Natural disaster loss values from the Insurance Information Institute, 2015; Fire loss values estimated from FEMA, 2015.

As shown in **Table 3-1**, using available dollar-value loss estimates from previous events for which disaster debris volumes were also found, we developed estimates for the volume of disaster debris generated by dollar-value loss for each event. These values were used to generate an average estimate of 1.8 million cubic yards of debris generated per $1 billion in dollar-value loss.

Disaster debris contains many different materials other than wood, so we used the wood composition factor for construction and demolition waste of 10 percent based on EPA (2016). Therefore, assuming 10 percent of disaster and fire debris is wood, and an average wood waste density of 364 pounds per cubic yard (New Jersey Department of Environmental Protection, 2015), we found a rough estimate of 0.916 million metric tons (1.8 million CY of total debris * 30.6 * 0.1 * 364 / 2200) of catastrophic wood waste per year.

Table 3-1. Reported Disaster Debris Generated, Dollar-Value Loss and Calculated Debris Per Dollar-Value Loss (Insurance Information Institute (2015) and the Federal Emergency Management Agency (FEMA, 2015))

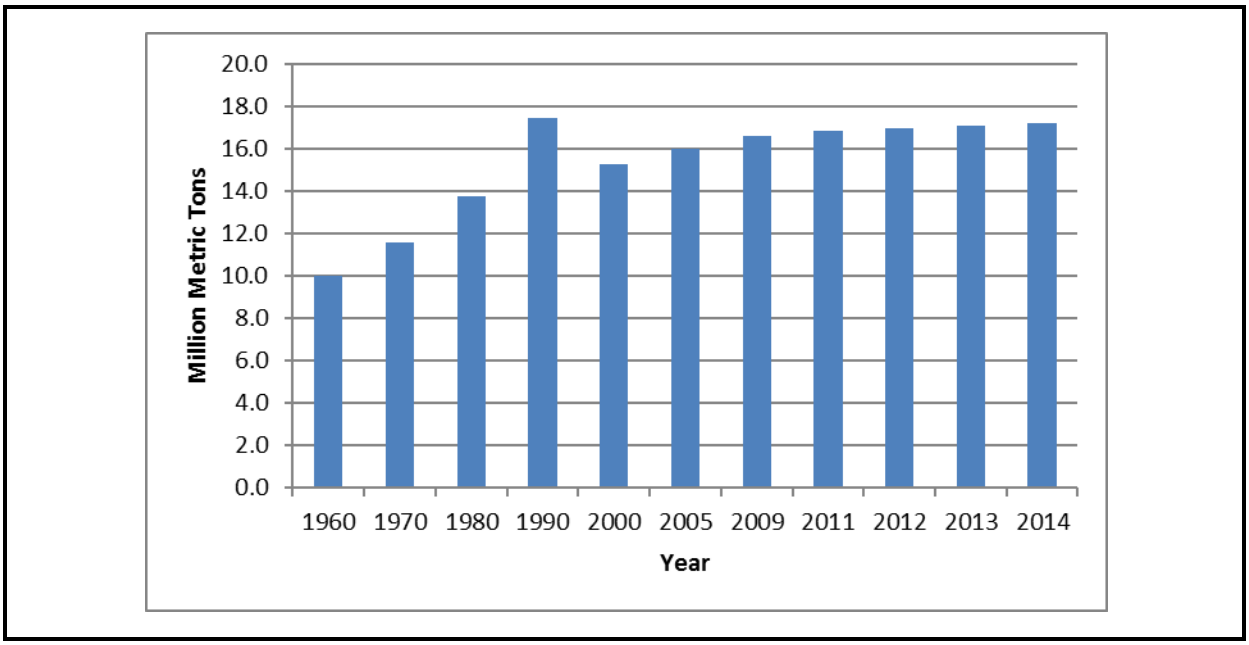
Event	Year	Debris Generated (million cubic yards [CY])	Value of Loss ($billion)	Million CY of Debris Per $Billion of Loss
Hurricane Andrew	1992	43	24	1.8
Hurricane Fran	1996	3.5	2.3	1.5
Tropical Storm Allison	2001	1.2	9	0.1
Hurricane Isabel	2003	20	5.37	3.7
Hurricane Charley	2004	18	15.1	1.2
Hurricane Jeanne	2004	5.1	7.66	0.7
Hurricane Katrina	2005	114	48	2.4
Hurricane Rita	2005	17.2	12	1.4
Hurricane Ike	2008	25	29.5	0.9
Hurricane Gustav	2008	15	15	1.0
Super Storm Sandy	2012	100	19.3	5.2
				Average = 1.8

3.3.2 Municipal Solid Wastes

In addition to manufactured (dimensional) wood products, wood waste enters the solid waste stream from the MSW stream as part of yard trimmings. Data for characterizing the quantity of woody yard trimmings generation in the United States are limited. EPA does not include woody yard trimmings as part of their MSW generation estimates, but rather a composite "yard trimmings" category and estimate. According to Dovetail Partners (2014), the U.S. Forest Service developed estimates of woody yard trimming by using EPA data on yard trimmings and an estimated woody component of 55 percent sourced from Falk et al. (2012).

As reported in Dovetail Partners (2014), the U.S. Forest Service estimated 16.7 million metric tons of woody yard trimmings generated in 2010. If the 55 percent factor is applied to the EPA's (2016 most recent estimate for total yard trimmings of 34.5 million metric tons for 2014), the amount of woody yard trimmings generated can be estimated at 17.2 million metric tons. Applying the 55 percent factor across the EPA's (2016) most recent MSW statistics is shown in **Figure 3-11**. As shown in the figure, woody yard trimmings have increased in the waste stream in the past 50 years but seem to have leveled off near approximately 17 million metric tons per year.

Figure 3-11. Woody Yard Trimmings Generated in the United States since 1960



Source: EPA, 2016.

4. KEY FINDINGS AND FUTURE RESEARCH NEEDS

Using publicly available U.S. government data characterizing logs and wood product production and a materials flow methodology constructed using wood product service life estimates, we generated estimates for wood waste generated and wood that remains in service. In this section, key findings from this research are summarized as well as identified data gaps and future research needs.

4.1 Key Findings

According to the results generated from this analysis, the amount of wood waste generated in the United States will continue to increase in more or less a linear fashion. However, an uptick in wood waste generated will occur during the last half of our future forecast (2045–2065) as wood consumption rose through 2005 when consumption peaked. This peak wood consumption will begin entering the waste stream at peak levels by 2045–2050, based on wood service life assumptions used in the analysis.

Additional findings include the following:

- The projected annual generation of untreated wood waste will outpace treated wood waste in future years. By 2050, the amount of untreated wood waste generated is estimated to be more than double the amount of treated wood waste. Since untreated wood product comprises approximately 70 percent of the market, it is not unexpected that most wood waste generated is untreated. However, this also means that over time the fraction of untreated wood in the waste stream will continue to grow relative to treated wood.
- Regarding wood remaining in service, the shorter service life for treated wood–due to its typical exposure to the environment–also impacts the amount of treated versus untreated wood remaining in service. Treated wood appears to move in and out of service relatively quickly, and thus the amount remaining in service is relatively constant. Untreated wood drives most of the wood remaining in service due to its assumed longer service life.
- There are regional differences that impact wood consumption and waste generation. The South region of the United States consumes approximately 50 percent of wood product produced. Thus, there is a significantly larger amount of wood waste generated in the South region. For wood remaining in service, however, the story differs by type of wood. For treated wood, the wet and warm climate in the South region shortens the service life and thus less wood remains in service for less time than in other regions (e.g., the arid West). Untreated wood is typically used for indoor applications and is less impacted by weather. Thus, untreated wood remaining in service is significantly higher in the South region, in line with its significantly higher consumption.
- The amount of wood waste residuals generated from wood product manufacturing has decreased by approximately 30 percent in the last 50 years. Given the hundreds of millions of metric tons of wood product produced, the amount of wood waste reduction from production efficiency improvement is significant and currently in the tens of millions of metric tons per year.

4.2 Data Gaps and Research Needs

Data characterizing the production and consumption of logs and wood products in the United States are readily available and updated on a regular basis by government sources. The production and consumption of dimensional wood products in this country are driven by economic activity. Thus, historical data for wood consumption in combination with service life estimates for wood products can be used as a reasonable predictor for how much wood waste may be anticipated in the future. The assumed service lives for different wood products and applications are critical for accurately forecasting wood waste generation. Thus, refining service life estimates is a key area for future research that will improve the accuracy of the wood waste inventory.

Additional data gaps and future research needs identified through this project include the following:

- *Production and consumption data for treated versus untreated wood products.* Although U.S. government sources (e.g., U.S. Forest Service, U.S. Census Bureau, and U.S. Geological Survey) publish data characterizing the production and consumption of logs and wood products in the country, the data do not differentiate treated and untreated wood product. The most recent data we found for characterizing the amount of treated wood produced was published by SFPA (2009) and are almost 10 years old. Given the significant changes in the wood preservation and treatment industry since the 2004 phase-out of CCA, research and characterization of the current and projected state-of-practice for treated wood is needed.

- *Regional wood consumption.* While the U.S. government sources for wood products provide good regional or state-level production statistics, data characterizing the location where wood products are consumed are not included. For our wood waste inventory, U.S. Census data detailing the authorizations for residential housing permits and housing starts by U.S. Census region were used as a proxy for regional wood consumption. Additional research can be done to refine the regional split for wood consumption, such as development of state-level consumption estimates from the housing permit and starts data. Such information could be valuable for use by states, for example, to approximate future amounts of wood waste that will be generated in their state. In addition, since most wood consumed in the United States is used in construction, this approach appears to be reasonable for wood. No data, however, were found to estimate treated wood consumed by state or U.S. region. While construction activity may be an indicator, there also may be other factors to consider such as architecture as related to the climate or scenery (e.g., decks may be more common in regions with more moderate climate or nicer views), urban population density (e.g., smaller total number of utility poles, or higher likelihood that cables are buried), and so forth. A more detailed analysis and geospatial analysis would help to discern wood use patterns.

- *Service life for untreated wood and potential regional adjustment factors.* Considerable research has gone into developing service life estimates for treated wood products, as well as U.S. regional service life adjustment factors. Comparable research has not been done to develop service life estimates and regional service life adjustment factors for untreated wood products. Since untreated wood represents approximately 70 percent of the total wood consumed in the United States, additional research and characterization of service life can help improve the wood waste inventory. Specifically, review and

refinement of untreated wood product/application "bins," associated base service life estimates, and regional service life adjustment factors are needed.

- *Woody biomass fraction of yard waste.* Data characterizing woody biomass waste is limited. EPA (2016) has included "yard trimmings" as part of their MSW characterization for years, but this source does not specify the woody component for yard trimmings. Dovetail (2014) prepared a summary of the state of data for woody biomass across U.S. government sources. Additional research is needed to better understand and characterize the woody fraction from the MSW (including commercial, institutional, and industrial) waste streams.
- *Dimensional wood and woody debris from catastrophes.* Significant quantities of dimensional wood from buildings and structures enter the waste stream as disaster debris each year. In addition to dimensional wood, significant amounts of woody debris (e.g., trees, branches) are generated via hurricanes, floods, and fires. While statistics and data characterizing the number of disasters and dollar-value of damage are readily available, data characterizing the amount of disaster debris generated and, specifically, the wood/woody biomass fraction of debris is limited. Additional research is needed to better approximate wood and woody biomass generated from disasters, and specifically, U.S. regional variations in disasters and the anticipated amounts of wood/woody biomass contained in disaster debris.
- *Weight of wood through time.* In this analysis, it was assumed that the weight of wood waste generated remains constant through time. It is likely that the weight of wood changes due to moisture gains or losses after the wood is consumed. Additional research is needed to better understand and characterize how wood weight can change through time due to environmental factors (e.g., regional weather) and exposure to moisture.

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Appendix A:
Wood Resource and Product Production Data

Table A-1 contains raw data collected and compiled from the U.S. Geological Survey (2013) for logs and wood product production. In addition, forecasted data for logs and wood product production are included in **Table A-2** based on a straight 1 percent annual growth rate for the years 2012 to 2065. **Tables A-3** through **A-7** show the average imports and exports as a fraction of production used to back calculate log and wood product imports and exports from 1900 through 1965, which were not included in the U.S. Geological Survey or U.S. Forest Service data.

Table A-1. Historical Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 1900–2011

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
1900	87,900,488	41,130,385	2,161,525	15,967	na	21,900,000	63,046,353
1901	91,459,801	43,595,967	2,391,942	15,967	na	22,300,000	65,911,935
1902	95,078,870	46,173,621	2,622,358	31,935	na	22,800,000	69,005,556
1903	99,121,047	48,751,274	2,863,747	46,762	na	23,600,000	72,398,036
1904	102,439,411	50,208,209	3,094,163	62,729	na	24,000,000	74,270,938
1905	104,068,233	50,768,568	3,291,663	109,491	na	24,500,000	75,378,060
1906	111,308,298	53,682,438	3,500,135	188,188	na	26,900,000	80,770,626
1907	115,289,756	53,682,438	3,697,635	204,155	na	31,600,000	85,486,593
1908	105,274,910	48,975,418	3,906,107	220,123	na	28,900,000	78,095,541
1909	111,911,637	51,889,287	4,103,606	250,917	na	30,700,000	82,840,204
1910	112,152,587	51,777,216	4,312,078	282,852	na	31,100,000	83,160,067
1911	108,834,224	49,871,993	4,509,578	250,917	na	30,200,000	80,322,910
1912	112,574,731	52,113,431	4,718,050	250,917	na	30,200,000	82,564,348
1913	110,644,240	50,880,640	4,926,522	250,917	na	29,900,000	81,031,557
1914	103,344,419	46,733,980	5,134,994	266,884	na	28,800,000	75,800,865
1915	96,768,411	42,139,033	5,343,466	266,884	na	28,200,000	70,605,917
1916	102,922,274	45,613,261	5,562,910	282,852	1,045	28,900,000	74,797,158
1917	95,803,648	40,345,882	5,782,354	282,852	3,135	28,900,000	69,531,869
1918	88,202,157	36,199,222	5,914,021	297,679	4,180	28,700,000	65,201,081
1919	93,209,098	39,449,307	5,935,965	329,614	6,269	28,700,000	68,485,190
1920	93,993,631	40,121,738	7,153,881	294,257	7,314	28,300,000	68,723,310
1921	79,393,989	32,837,065	5,310,549	287,414	9,404	25,700,000	58,833,883
1922	91,761,470	39,561,379	6,846,659	343,300	10,449	25,400,000	65,315,128
1923	103,103,469	46,285,693	7,834,158	429,981	11,494	25,500,000	72,227,167

(continued)

Table A-1. Historical Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 1900–2011 (continued)

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
1924	99,664,630	44,940,830	7,889,019	437,964	13,584	24,800,000	70,192,378
1925	101,112,258	46,285,693	8,964,295	509,818	44,931	22,400,000	69,240,441
1926	99,241,522	45,052,902	9,754,294	554,299	61,649	22,300,000	67,968,850
1927	94,173,862	42,251,104	9,951,794	661,509	62,694	21,500,000	64,475,307
1928	92,786,954	41,466,601	10,357,766	674,054	71,053	20,700,000	62,911,709
1929	97,130,800	44,156,327	11,081,932	830,307	125,388	20,700,000	65,812,022
1930	76,558,489	33,621,569	10,127,349	659,227	108,670	17,900,000	52,289,466
1931	55,804,984	22,862,667	9,337,350	524,645	98,221	14,500,000	37,985,532
1932	40,963,428	15,353,850	7,965,824	553,158	54,335	12,400,000	28,361,343
1933	48,806,832	19,500,510	9,150,823	612,466	51,200	12,500,000	32,664,176
1934	52,547,340	21,741,948	9,139,851	653,525	59,559	12,800,000	35,255,032
1935	61,475,983	26,224,823	10,434,571	726,519	70,008	13,400,000	40,421,351
1936	72,274,398	31,492,203	11,959,708	913,566	85,682	14,600,000	47,091,451
1937	76,860,159	33,061,209	12,727,763	989,982	96,131	15,300,000	49,447,322
1938	67,206,738	28,130,046	11,301,376	1,010,511	103,445	13,800,000	43,044,002
1939	76,919,914	32,500,850	13,495,818	1,288,801	101,356	14,400,000	48,291,006
1940	84,159,980	34,966,431	14,373,594	1,414,260	156,735	14,400,000	50,937,426
1941	97,130,800	41,130,385	17,665,257	1,733,609	552,753	15,400,000	58,816,747
1942	97,552,945	41,018,314	17,006,925	1,938,904	752,330	15,000,000	58,709,548
1943	91,217,887	39,337,235	17,006,925	1,676,582	779,497	13,800,000	55,593,314
1944	89,951,454	38,328,588	17,116,647	1,630,961	785,767	13,500,000	54,245,315
1945	79,695,658	32,949,137	17,336,091	1,482,691	760,689	12,600,000	47,792,518
1946	92,968,148	39,785,523	19,201,367	1,471,286	820,249	13,300,000	55,377,057
1947	97,612,700	40,570,026	21,066,642	1,756,419	895,482	14,100,000	57,321,927

(continued)

Table A-1. Historical Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 1900–2011 (continued)

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
1948	100,931,064	42,026,961	21,834,697	1,813,446	1,065,801	12,700,000	57,606,207
1949	88,563,582	36,087,150	19,969,421	1,859,067	684,411	11,200,000	49,830,628
1950	102,826,858	43,035,608	24,248,583	2,326,685	1,076,250	11,500,000	57,938,542
1951	105,601,638	42,475,248	25,894,414	2,509,170	1,086,699	10,900,000	56,971,117
1952	105,631,516	42,363,176	24,358,305	2,634,629	1,170,291	10,500,000	56,668,096
1953	105,786,688	41,690,745	26,443,025	3,011,004	1,232,985	11,200,000	57,134,734
1954	105,314,426	41,242,457	26,333,303	3,011,004	1,337,475	11,100,000	56,690,937
1955	111,024,941	42,587,320	30,063,854	3,912,024	1,515,109	11,700,000	59,714,453
1956	115,880,565	43,595,967	31,270,797	3,991,862	1,588,252	10,900,000	60,076,081
1957	103,369,478	39,673,451	30,502,742	4,003,267	1,650,946	10,200,000	55,527,664
1958	102,270,746	40,345,882	30,722,187	4,448,074	1,839,029	10,000,000	56,632,985
1959	112,652,799	44,940,830	33,574,961	5,292,068	2,100,254	10,900,000	63,233,152
1960	107,156,248	40,233,810	33,574,961	5,143,799	1,870,376	7,630,000	54,877,985
1961	104,586,757	38,888,948	34,781,904	5,691,254	2,016,662	7,330,000	53,926,864
1962	108,108,482	40,570,026	36,537,458	6,295,736	2,215,193	6,960,000	56,040,956
1963	113,798,757	43,035,608	38,073,567	7,014,271	2,465,970	7,710,000	60,225,849
1964	120,956,900	45,052,902	40,816,619	7,778,428	2,716,747	8,080,000	63,628,076
1965	137,425,000	46,081,000	41,240,000	6,807,800	2,862,400	7,730,000	63,481,200
1966	140,540,000	46,060,000	44,770,000	7,180,600	3,014,000	7,800,000	64,054,600
1967	135,304,000	44,470,000	44,220,000	7,036,300	3,194,000	7,110,000	61,810,300
1968	138,923,000	45,620,000	46,790,000	8,190,300	3,886,000	7,110,000	64,806,300
1969	137,478,000	44,910,000	49,440,000	7,772,000	4,433,000	8,280,000	65,395,000
1970	135,997,000	43,200,000	48,200,000	7,979,400	4,325,000	9,000,000	64,504,400
1971	142,105,000	47,030,000	48,970,000	9,322,400	5,533,000	8,310,000	70,195,400

(continued)

Table A-1. Historical Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 1900–2011 (continued)

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
1972	142,797,400	49,460,000	52,840,000	10,365,000	6,700,000	7,140,000	73,665,000
1973	146,230,000	50,110,000	55,860,000	9,774,000	7,210,000	6,830,000	73,924,000
1974	142,260,000	44,090,000	55,200,000	7,954,000	6,337,000	5,910,000	64,291,000
1975	124,525,000	40,300,000	46,730,000	7,889,000	5,445,000	5,310,000	58,944,000
1976	139,447,000	45,950,000	53,750,000	9,180,000	6,807,000	5,180,000	67,117,000
1977	145,385,000	51,040,000	55,610,000	9,777,000	7,788,000	5,310,000	73,915,000
1978	149,184,000	53,050,000	58,300,000	10,205,000	8,200,000	5,450,000	76,905,000
1979	150,629,000	52,100,000	60,480,000	9,744,000	7,707,000	5,590,000	75,141,000
1980	140,478,000	45,270,000	58,820,000	7,804,000	6,542,000	5,730,000	65,346,000
1981	134,644,000	40,860,000	60,070,000	7,951,000	6,241,000	5,870,000	60,922,000
1982	129,833,000	41,100,000	57,270,000	8,132,000	5,559,000	6,000,000	60,791,000
1983	148,722,000	50,120,000	63,050,000	10,142,000	7,195,000	6,140,000	73,597,000
1984	154,089,000	54,990,000	68,090,000	10,295,000	7,546,000	6,280,000	79,111,000
1985	152,281,000	55,840,000	67,290,000	10,686,000	7,576,000	6,420,000	80,522,000
1986	171,787,000	59,930,000	70,610,000	11,430,000	7,829,000	6,560,000	85,749,000
1987	179,280,000	63,690,000	74,470,000	12,102,000	7,979,000	6,830,000	90,601,000
1988	179,490,000	61,700,000	76,760,000	11,533,000	8,032,000	7,040,000	88,305,000
1989	177,972,500	63,300,000	76,230,000	10,017,000	7,800,000	7,660,000	88,777,000
1990	178,214,000	60,480,000	77,820,000	9,543,000	7,553,000	7,760,000	85,336,000
1991	171,297,600	54,870,000	76,260,000	8,546,000	7,361,000	7,600,000	78,377,000
1992	177,564,000	58,280,000	79,430,000	8,859,000	7,803,000	7,540,000	82,482,000
1993	175,830,000	60,130,000	82,600,000	8,955,000	8,266,000	7,140,000	84,491,000
1994	180,778,000	62,610,000	86,360,000	9,297,000	8,855,000	5,530,000	86,292,000
1995	181,662,000	62,440,000	87,190,000	9,336,000	8,174,000	5,340,000	85,290,000

(continued)

Table A-1. Historical Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 1900–2011 (continued)

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
1996	181,938,000	63,960,000	85,530,000	9,125,000	8,755,000	4,720,000	86,560,000
1997	183,543,000	65,580,000	90,000,000	8,715,000	8,934,000	4,550,000	87,779,000
1998	186,763,000	67,090,000	91,540,000	9,281,000	9,131,000	4,210,000	89,712,000
1999	192,362,000	69,490,000	95,100,000	9,544,000	9,642,000	4,110,000	92,786,000
2000	190,478,000	68,480,000	93,510,000	9,610,000	9,706,000	4,140,000	91,936,000
2001	181,058,000	66,780,000	88,190,000	8,830,000	8,892,000	4,410,000	88,912,000
2002	180,597,000	68,890,000	88,160,000	9,396,000	9,447,000	4,380,000	92,113,000
2003	175,352,000	67,890,000	90,940,000	9,331,000	9,530,000	4,390,000	91,141,000
2004	182,973,000	74,330,000	94,590,000	10,424,000	10,257,000	4,390,000	99,401,000
2005	184,487,000	75,240,000	92,440,000	10,483,000	10,382,000	4,390,000	100,495,000
2006	179,710,000	71,700,000	92,970,000	9,745,000	10,098,000	4,420,000	95,963,000
2007	169,172,000	63,690,000	90,580,000	8,440,000	9,115,000	4,490,000	85,735,000
2008	142,670,000	47,100,000	84,950,000	6,562,000	7,531,000	4,000,000	65,193,000
2009	129,849,000	38,910,000	74,170,000	5,580,000	6,213,000	4,050,000	54,753,000
2010	130,630,000	39,340,000	77,440,000	5,793,000	6,090,000	4,050,000	55,273,000
2011	140,107,000	42,670,000	75,620,000	5,841,000	5,988,000	5,960,000	60,459,000

Table A-2. Forecasted* Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 2012–2065

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
2012	141,508,070	43,096,700	76,376,200	5,899,410	6,047,880	6,019,600	61,063,590
2013	142,923,151	43,527,667	77,139,962	5,958,404	6,108,359	6,079,796	61,674,226
2014	144,352,382	43,962,944	77,911,362	6,017,988	6,169,442	6,140,594	62,290,968
2015	145,795,906	44,402,573	78,690,475	6,078,168	6,231,137	6,202,000	62,913,878
2016	147,253,865	44,846,599	79,477,380	6,138,950	6,293,448	6,264,020	63,543,017
2017	148,726,404	45,295,065	80,272,154	6,200,339	6,356,383	6,326,660	64,178,447
2018	150,213,668	45,748,015	81,074,875	6,262,343	6,419,946	6,389,927	64,820,231
2019	151,715,804	46,205,496	81,885,624	6,324,966	6,484,146	6,453,826	65,468,434
2020	153,232,962	46,667,551	82,704,480	6,388,216	6,548,987	6,518,364	66,123,118
2021	154,765,292	47,134,226	83,531,525	6,452,098	6,614,477	6,583,548	66,784,349
2022	156,312,945	47,605,568	84,366,840	6,516,619	6,680,622	6,649,383	67,452,193
2023	157,876,074	48,081,624	85,210,509	6,581,785	6,747,428	6,715,877	68,126,714
2024	159,454,835	48,562,440	86,062,614	6,647,603	6,814,903	6,783,036	68,807,982
2025	161,049,384	49,048,065	86,923,240	6,714,079	6,883,052	6,850,866	69,496,061
2026	162,659,877	49,538,545	87,792,472	6,781,220	6,951,882	6,919,375	70,191,022
2027	164,286,476	50,033,931	88,670,397	6,849,032	7,021,401	6,988,569	70,892,932
2028	165,929,341	50,534,270	89,557,101	6,917,522	7,091,615	7,058,454	71,601,862
2029	167,588,634	51,039,613	90,452,672	6,986,697	7,162,531	7,129,039	72,317,880
2030	169,264,521	51,550,009	91,357,199	7,056,564	7,234,156	7,200,329	73,041,059
2031	170,957,166	52,065,509	92,270,771	7,127,130	7,306,498	7,272,333	73,771,470
2032	172,666,738	52,586,164	93,193,479	7,198,401	7,379,563	7,345,056	74,509,184
2033	174,393,405	53,112,026	94,125,413	7,270,385	7,453,359	7,418,507	75,254,276
2034	176,137,339	53,643,146	95,066,667	7,343,089	7,527,892	7,492,692	76,006,819
2035	177,898,712	54,179,577	96,017,334	7,416,520	7,603,171	7,567,619	76,766,887

(continued)

Table A-2. Forecasted* Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 2012–2065 (continued)

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
2036	179,677,700	54,721,373	96,977,507	7,490,685	7,679,203	7,643,295	77,534,556
2037	181,474,477	55,268,587	97,947,283	7,565,592	7,755,995	7,719,728	78,309,902
2038	183,289,221	55,821,273	98,926,755	7,641,248	7,833,555	7,796,925	79,093,001
2039	185,122,113	56,379,486	99,916,023	7,717,661	7,911,890	7,874,894	79,883,931
2040	186,973,335	56,943,280	100,915,183	7,794,837	7,991,009	7,953,643	80,682,770
2041	188,843,068	57,512,713	101,924,335	7,872,786	8,070,919	8,033,180	81,489,598
2042	190,731,499	58,087,840	102,943,578	7,951,513	8,151,628	8,113,511	82,304,494
2043	192,638,814	58,668,719	103,973,014	8,031,029	8,233,145	8,194,646	83,127,538
2044	194,565,202	59,255,406	105,012,744	8,111,339	8,315,476	8,276,593	83,958,814
2045	196,510,854	59,847,960	106,062,872	8,192,452	8,398,631	8,359,359	84,798,402
2046	198,475,962	60,446,440	107,123,500	8,274,377	8,482,617	8,442,952	85,646,386
2047	200,460,722	61,050,904	108,194,735	8,357,120	8,567,443	8,527,382	86,502,850
2048	202,465,329	61,661,413	109,276,683	8,440,692	8,653,118	8,612,656	87,367,878
2049	204,489,982	62,278,027	110,369,450	8,525,099	8,739,649	8,698,782	88,241,557
2050	206,534,882	62,900,807	111,473,144	8,610,350	8,827,046	8,785,770	89,123,973
2051	208,600,231	63,529,816	112,587,876	8,696,453	8,915,316	8,873,628	90,015,212
2052	210,686,233	64,165,114	113,713,754	8,783,418	9,004,469	8,962,364	90,915,365
2053	212,793,096	64,806,765	114,850,892	8,871,252	9,094,514	9,051,988	91,824,518
2054	214,921,027	65,454,832	115,999,401	8,959,964	9,185,459	9,142,508	92,742,763
2055	217,070,237	66,109,381	117,159,395	9,049,564	9,277,314	9,233,933	93,670,191
2056	219,240,939	66,770,475	118,330,989	9,140,060	9,370,087	9,326,272	94,606,893
2057	221,433,349	67,438,179	119,514,299	9,231,460	9,463,788	9,419,535	95,552,962
2058	223,647,682	68,112,561	120,709,442	9,323,775	9,558,425	9,513,730	96,508,492
2059	225,884,159	68,793,687	121,916,536	9,417,013	9,654,010	9,608,867	97,473,576

(continued)

Table A-2. Forecasted* Net (Production+Imports-Exports) Metric Tons of Logs and Wood Product Production in the United States, 2012–2065 (continued)

	Wood Resource		Wood Product Production				
Year	Logs	Lumber	Paper and Board	Plywood and Veneer	Panel	Other Industrial	Total Excluding Paper
2060	228,143,001	69,481,624	123,135,701	9,511,183	9,750,550	9,704,956	98,448,312
2061	230,424,431	70,176,440	124,367,058	9,606,294	9,848,055	9,802,006	99,432,795
2062	232,728,675	70,878,204	125,610,729	9,702,357	9,946,536	9,900,026	100,427,123
2063	235,055,962	71,586,986	126,866,836	9,799,381	10,046,001	9,999,026	101,431,395
2064	237,406,521	72,302,856	128,135,505	9,897,375	10,146,461	10,099,016	102,445,708
2065	239,780,587	73,025,885	129,416,860	9,996,349	10,247,926	10,200,006	103,470,166

*Based on 1 percent annual growth rate.

Table A-3. Average Log Imports and Exports as a Fraction of Production Used to Back Calculate Log Imports and Exports, 1900–1965

Year	Fraction of Imports to Production	Fraction of Exports to Production
1965	0.0011	0.0192
1966	0.0015	0.0218
1967	0.0012	0.0317
1968	0.0012	0.0400
1969	0.0013	0.0378
1970	0.0023	0.0434
1971	0.0013	0.0350
1972	0.0006	0.0471
1973	0.0000	0.0492
1974	0.0012	0.0401
1975	0.0015	0.0460
10-Year Average	0.0012	0.0374

Table A-4. Average Lumber Imports and Exports as a Fraction of Production Used to Back Calculate Log Imports and Exports, 1900–1965

Year	Fraction of Imports to Production	Fraction of Exports to Production
1965	0.1150	0.0204
1966	0.1149	0.0260
1967	0.1164	0.0291
1968	0.1380	0.0254
1969	0.1459	0.0259
1970	0.1452	0.0289
1971	0.1682	0.0267
1972	0.2043	0.0322
1973	0.2037	0.0438
1974	0.1716	0.0440
1975	0.1495	0.0423
10-Year Average	0.1521	0.0313

Table A-5. Average Paper Imports and Exports as a Fraction of Production Used to Back Calculate Log Imports and Exports, 1900–1965

Year	Fraction of Imports to Production	Fraction of Exports to Production
1965	0.1616	0.0379
1966	0.1636	0.0387
1967	0.1557	0.0418
1968	0.1410	0.0452
1969	0.1416	0.0478
1970	0.1405	0.0500
1971	0.1395	0.0537
1972	0.1346	0.0518
1973	0.1395	0.0464
1974	0.1457	0.0547
1975	0.1244	0.0501
10-Year Average	0.1443	0.0471

Table A-6. Average Plywood and Veneer Imports and Exports as a Fraction of Production Used to Back Calculate Log Imports and Exports, 1900–1965

Year	Fraction of Imports to Production	Fraction of Exports to Production
1965	0.1010	0.0029
1966	0.1159	0.0044
1967	0.1172	0.0074
1968	0.1592	0.0056
1969	0.1903	0.0163
1970	0.1781	0.0132
1971	0.1934	0.0073
1972	0.2184	0.0145
1973	0.1779	0.0266
1974	0.1349	0.0423
1975	0.1604	0.0601
10-Year Average	0.1588	0.0182

Table A-7. Average Wood Panel Imports and Exports as a Fraction of Production Used to Back Calculate Log Imports and Exports, 1900–1965

Year	Fraction of Imports to Production	Fraction of Exports to Production
1965	0.0842	0.0081
1966	0.0633	0.0094
1967	0.0592	0.0086
1968	0.0670	0.0082
1969	0.0655	0.0100
1970	0.0457	0.0110
1971	0.0484	0.0103
1972	0.0643	0.0108
1973	0.0598	0.0134
1974	0.0455	0.0201
1975	0.0197	0.0188
10-Year Average	0.0566	0.0117

Appendix B:
Wood Waste Generated and Wood Remaining In Service, Detailed Results

Table B-1 contains our calculated estimates for wood waste generated and wood remaining in service from 1900 through 2065. The table contains estimates for the annual amounts of treated and untreated and total wood waste generated and remaining in service. The table also includes estimated cumulative amounts of wood waste generated and remaining in service since 1900. **Table B-2** contains estimates for treated, untreated, and total wood waste generated by U.S. Census region. **Table B-3** contains estimates for treated, untreated, and total wood remaining in service by U.S. Census region.

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
1900	0	0	0	16,620,595	38,781,388	55,401,983	0	55,401,983
1901	0	0	0	33,996,629	79,325,467	113,322,096	0	113,322,096
1902	0	0	0	52,188,219	121,772,509	173,960,728	0	173,960,728
1903	0	0	0	71,274,151	166,306,351	237,580,502	0	237,580,502
1904	0	0	0	90,853,827	211,992,262	302,846,089	0	302,846,089
1905	0	0	0	110,725,368	258,359,191	369,084,559	0	369,084,559
1906	5,318,590	0	5,318,590	126,699,934	308,043,222	434,743,156	5,318,590	440,061,746
1907	5,560,331	0	5,560,331	143,676,006	360,628,162	504,304,168	10,878,921	515,183,089
1908	5,821,309	0	5,821,309	158,442,634	408,666,682	567,109,316	16,700,230	583,809,546
1909	6,107,498	0	6,107,498	174,173,885	459,623,763	633,797,648	22,807,728	656,605,376
1910	7,329,214	0	7,329,214	188,767,744	510,777,599	699,545,343	30,136,942	729,682,285
1911	7,470,959	0	7,470,959	202,471,912	560,186,229	762,658,141	37,607,901	800,266,042
1912	12,232,944	0	12,232,944	212,004,994	610,973,624	822,978,618	49,840,845	872,819,463
1913	12,881,413	0	12,881,413	220,485,525	660,818,161	881,303,686	62,722,258	944,025,944
1914	12,498,286	0	12,498,286	227,970,242	707,445,168	935,415,410	75,220,544	1,010,635,954
1915	14,974,443	0	14,974,443	231,609,285	750,876,633	982,485,918	90,194,986	1,072,680,904
1916	15,301,906	0	15,301,906	236,025,780	796,886,235	1,032,912,015	105,496,892	1,138,408,907
1917	15,306,561	0	15,306,561	239,049,558	839,657,026	1,078,706,584	120,803,453	1,199,510,037
1918	15,833,257	0	15,833,257	240,404,937	879,763,841	1,120,168,778	136,636,709	1,256,805,487
1919	16,156,585	0	16,156,585	242,302,760	921,890,794	1,164,193,554	152,793,294	1,316,986,848

(continued)

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
1920	15,254,019	0	15,254,019	245,165,924	964,164,220	1,209,330,144	168,047,313	1,377,377,457
1921	15,244,490	0	15,244,490	245,431,517	1,000,354,413	1,245,785,930	183,291,804	1,429,077,733
1922	15,794,225	0	15,794,225	246,855,993	1,040,531,381	1,287,387,374	199,086,029	1,486,473,402
1923	14,918,378	0	14,918,378	250,978,502	1,084,960,117	1,335,938,619	214,004,406	1,549,943,025
1924	15,917,082	0	15,917,082	253,565,886	1,128,137,203	1,381,703,089	229,921,488	1,611,624,577
1925	16,430,845	0	16,430,845	255,388,552	1,170,728,729	1,426,117,281	246,352,333	1,672,469,614
1926	16,160,072	0	16,160,072	257,146,768	1,212,538,068	1,469,684,836	262,512,405	1,732,197,241
1927	15,031,913	0	15,031,913	259,112,158	1,252,198,441	1,511,310,599	277,544,319	1,788,854,917
1928	15,798,249	0	15,798,249	259,899,008	1,290,897,006	1,550,796,014	293,342,567	1,844,138,581
1929	15,961,024	0	15,961,024	261,287,678	1,331,379,626	1,592,667,304	309,303,591	1,901,970,895
1930	16,919,010	0	16,919,010	258,153,478	1,363,544,184	1,621,697,662	326,222,601	1,947,920,263
1931	17,199,810	0	17,199,810	250,967,604	1,386,910,034	1,637,877,638	343,422,411	1,981,300,049
1932	17,028,001	0	17,028,001	241,416,362	1,404,355,805	1,645,772,167	360,450,412	2,006,222,579
1933	16,180,294	0	16,180,294	233,847,161	1,424,448,356	1,658,295,517	376,630,706	2,034,926,223
1934	16,623,569	0	16,623,569	226,517,700	1,446,134,607	1,672,652,307	393,254,275	2,065,906,582
1935	17,300,746	0	17,300,746	219,873,033	1,470,998,790	1,690,871,823	410,555,021	2,101,426,844
1936	15,864,435	0	15,864,435	216,423,082	1,499,965,919	1,716,389,001	426,419,456	2,142,808,457
1937	14,816,635	0	14,816,635	214,641,998	1,530,382,203	1,745,024,201	441,236,090	2,186,260,291
1938	13,816,100	0	13,816,100	212,173,373	1,556,859,645	1,769,033,018	455,052,190	2,224,085,208
1939	13,917,111	0	13,917,111	210,986,979	1,586,564,650	1,797,551,629	468,969,301	2,266,520,930
1940	14,061,717	0	14,061,717	210,353,641	1,617,897,534	1,828,251,175	483,031,018	2,311,282,193
1941	14,286,975	0	14,286,975	211,572,231	1,654,077,186	1,865,649,417	497,317,993	2,362,967,410

(continued)

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
1942	13,626,327	0	13,626,327	213,423,209	1,690,190,897	1,903,614,106	510,944,320	2,414,558,426
1943	12,899,428	0	12,899,428	215,179,570	1,724,387,735	1,939,567,305	523,843,747	2,463,411,052
1944	11,746,551	0	11,746,551	217,733,440	1,757,755,385	1,975,488,825	535,590,298	2,511,079,123
1945	11,877,059	0	11,877,059	218,455,683	1,787,153,757	2,005,609,440	547,467,357	2,553,076,797
1946	12,152,286	0	12,152,286	220,902,173	1,821,217,569	2,042,119,742	559,619,644	2,601,739,386
1947	12,986,709	0	12,986,709	223,026,957	1,856,477,719	2,079,504,676	572,606,353	2,652,111,029
1948	14,250,100	0	14,250,100	223,963,294	1,891,912,737	2,115,876,031	586,856,452	2,702,732,483
1949	14,416,503	0	14,416,503	222,683,390	1,922,564,802	2,145,248,192	601,272,955	2,746,521,147
1950	14,088,495	11,634,416	25,722,911	223,868,943	1,946,569,832	2,170,438,775	626,995,866	2,797,434,641
1951	13,962,955	12,163,224	26,126,179	224,924,999	1,969,450,966	2,194,375,965	653,122,045	2,847,498,010
1952	14,985,062	12,734,113	27,719,175	224,879,064	1,991,574,816	2,216,453,880	680,841,220	2,897,295,100
1953	15,658,117	13,360,153	29,018,270	224,283,091	2,013,359,666	2,237,642,757	709,859,490	2,947,502,247
1954	15,584,658	13,705,773	29,290,431	223,643,581	2,034,525,906	2,258,169,487	739,149,921	2,997,319,408
1955	14,372,248	13,910,079	28,282,327	225,013,556	2,057,347,680	2,282,361,236	767,432,249	3,049,793,484
1956	14,938,007	14,905,209	29,843,216	225,913,105	2,079,396,770	2,305,309,875	797,275,465	3,102,585,340
1957	14,443,766	15,775,482	30,219,248	226,107,820	2,097,777,742	2,323,885,562	827,494,712	3,151,380,274
1958	14,869,729	14,411,556	29,281,285	226,167,961	2,118,202,551	2,344,370,512	856,775,998	3,201,146,510
1959	15,017,955	15,287,124	30,305,079	227,819,846	2,141,811,720	2,369,631,566	887,081,077	3,256,712,643
1960	14,822,686	15,346,151	30,168,837	227,464,369	2,160,222,389	2,387,686,758	917,249,914	3,304,936,672
1961	14,447,806	14,822,589	29,270,395	227,233,032	2,178,571,562	2,405,804,594	946,520,309	3,352,324,903
1962	14,695,713	15,236,218	29,931,931	227,311,116	2,197,807,537	2,425,118,653	976,452,240	3,401,570,893
1963	14,371,165	14,953,361	29,324,526	228,816,990	2,219,900,601	2,448,717,591	1,005,776,766	3,454,494,357

(continued)

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
1964	14,404,727	13,988,102	28,392,829	231,186,215	2,245,051,719	2,476,237,934	1,034,169,595	3,510,407,529
1965	15,478,503	13,029,439	28,507,942	232,442,943	2,271,071,153	2,503,514,096	1,062,677,537	3,566,191,633
1966	14,851,588	13,802,881	28,654,469	234,477,750	2,296,669,858	2,531,147,608	1,091,332,006	3,622,479,613
1967	14,921,989	12,831,237	27,753,226	235,850,500	2,321,859,682	2,557,710,182	1,119,085,232	3,676,795,414
1968	14,963,165	12,032,044	26,995,209	237,971,896	2,349,691,613	2,587,663,509	1,146,080,441	3,733,743,950
1969	14,967,264	12,638,086	27,605,350	240,244,389	2,377,279,626	2,617,524,015	1,173,685,791	3,791,209,806
1970	15,485,288	39,828,999	55,314,287	241,764,073	2,377,128,896	2,618,892,969	1,229,000,079	3,847,893,047
1971	16,224,690	39,237,913	55,462,603	244,044,645	2,381,069,928	2,625,114,573	1,284,462,681	3,909,577,254
1972	15,561,438	41,766,020	57,327,458	247,903,143	2,384,617,091	2,632,520,234	1,341,790,139	3,974,310,373
1973	15,198,274	44,502,310	59,700,584	252,193,084	2,385,587,282	2,637,780,366	1,401,490,723	4,039,271,089
1974	15,906,534	44,933,264	60,839,798	253,235,265	2,380,201,019	2,633,436,284	1,462,330,521	4,095,766,805
1975	15,840,824	45,234,308	61,075,132	252,933,553	2,371,224,639	2,624,158,192	1,523,405,653	4,147,563,845
1976	16,143,681	47,321,624	63,465,305	254,483,591	2,365,188,360	2,619,671,951	1,586,870,958	4,206,542,909
1977	16,740,787	48,707,570	65,448,357	257,228,646	2,361,947,754	2,619,176,400	1,652,319,316	4,271,495,715
1978	17,021,930	45,236,533	62,258,463	260,480,796	2,364,017,409	2,624,498,205	1,714,577,779	4,339,075,984
1979	16,681,941	47,814,743	64,496,684	263,607,901	2,362,423,774	2,626,031,675	1,779,074,463	4,405,106,138
1980	16,132,200	45,457,053	61,589,253	264,702,540	2,357,162,679	2,621,865,219	1,840,663,716	4,462,528,935
1981	15,821,826	41,595,796	57,417,622	264,941,276	2,353,041,528	2,617,982,804	1,898,081,338	4,516,064,142
1982	16,469,494	40,784,907	57,254,401	264,497,809	2,349,650,685	2,614,148,494	1,955,335,739	4,569,484,233
1983	17,722,100	40,918,941	58,641,041	266,177,718	2,354,003,099	2,620,180,817	2,013,976,780	4,634,157,597
1984	18,030,332	39,144,780	57,175,112	269,003,023	2,363,521,473	2,632,524,496	2,071,151,892	4,703,676,388
1985	17,798,056	37,861,280	55,659,336	272,432,579	2,375,191,288	2,647,623,867	2,126,811,228	4,774,435,095

(continued)

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
1986	16,599,911	40,896,860	57,496,771	278,438,248	2,387,040,782	2,665,479,030	2,184,307,999	4,849,787,029
1987	16,149,763	39,064,439	55,214,202	286,173,174	2,403,707,283	2,689,880,457	2,239,522,201	4,929,402,658
1988	16,901,065	36,018,003	52,919,068	292,551,514	2,422,007,893	2,714,559,407	2,292,441,270	5,007,000,677
1989	18,388,820	38,400,369	56,789,189	297,566,532	2,438,216,476	2,735,783,008	2,349,230,458	5,085,013,466
1990	18,579,692	38,991,263	57,570,955	301,483,543	2,451,717,520	2,753,201,063	2,406,801,413	5,160,002,476
1991	18,632,309	36,187,031	54,819,340	303,513,372	2,463,742,141	2,767,255,513	2,461,620,752	5,228,876,265
1992	18,677,434	38,957,991	57,635,425	306,580,255	2,475,520,890	2,782,101,145	2,519,256,177	5,301,357,322
1993	19,122,735	41,359,166	60,481,901	309,731,459	2,486,134,250	2,795,865,709	2,579,738,079	5,375,603,788
1994	19,138,323	40,234,256	59,372,579	313,341,866	2,498,980,361	2,812,322,227	2,639,110,657	5,451,432,884
1995	19,918,474	38,633,580	58,552,054	315,907,967	2,512,810,792	2,828,718,759	2,697,662,712	5,526,381,471
1996	20,076,087	39,485,681	59,561,768	318,651,260	2,526,570,331	2,845,221,591	2,757,224,480	5,602,446,071
1997	19,503,575	38,340,306	57,843,881	322,288,424	2,542,225,082	2,864,513,506	2,815,068,361	5,679,581,867
1998	20,552,271	37,719,500	58,271,771	325,386,480	2,559,689,676	2,885,076,156	2,873,340,132	5,758,416,287
1999	21,086,257	37,533,454	58,619,711	328,760,931	2,579,231,210	2,907,992,141	2,931,959,843	5,839,951,984
2000	21,129,938	33,207,024	54,336,962	331,867,622	2,602,576,318	2,934,443,940	2,986,296,804	5,920,740,744
2001	21,419,681	26,869,403	48,289,084	333,887,366	2,630,398,909	2,964,286,275	3,034,585,889	5,998,872,164
2002	21,680,900	22,669,429	44,350,329	336,489,757	2,664,390,489	3,000,880,246	3,078,936,217	6,079,816,463
2003	21,332,279	24,608,287	45,940,566	339,184,524	2,695,845,310	3,035,029,834	3,124,876,783	6,159,906,617
2004	21,419,893	25,641,980	47,061,873	343,969,220	2,731,347,370	3,075,316,590	3,171,938,656	6,247,255,246
2005	21,367,925	28,424,484	49,792,409	349,094,289	2,764,739,873	3,113,834,162	3,221,731,066	6,335,565,227
2006	21,417,355	31,363,280	52,780,635	352,975,179	2,792,405,833	3,145,381,012	3,274,511,701	6,419,892,713
2007	21,716,654	31,538,335	53,254,989	353,860,414	2,813,605,240	3,167,465,654	3,327,766,690	6,495,232,344

(continued)

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
2008	22,296,374	28,985,119	51,281,493	348,750,545	2,824,721,965	3,173,472,510	3,379,048,183	6,552,520,693
2009	22,405,961	32,462,392	54,868,353	340,778,844	2,825,939,512	3,166,718,356	3,433,916,536	6,600,634,892
2010	23,095,161	32,060,065	55,155,226	332,255,028	2,827,879,251	3,160,134,279	3,489,071,762	6,649,206,041
2011	23,480,723	35,277,285	58,758,008	324,712,809	2,829,791,808	3,154,504,617	3,547,829,770	6,702,334,387
2012	23,176,159	35,621,255	58,797,414	317,634,539	2,831,732,294	3,149,366,833	3,606,627,184	6,755,994,017
2013	22,440,165	35,051,714	57,491,879	311,453,242	2,834,617,938	3,146,071,180	3,664,119,064	6,810,190,243
2014	21,191,844	35,099,121	56,290,965	306,682,853	2,837,835,549	3,144,518,402	3,720,410,029	6,864,928,431
2015	20,070,827	32,293,523	52,364,350	303,197,697	2,844,241,925	3,147,439,622	3,772,774,379	6,920,214,001
2016	20,739,037	35,665,145	56,404,182	299,210,188	2,847,663,678	3,146,873,866	3,829,178,561	6,976,052,427
2017	21,377,842	36,088,423	57,466,265	294,751,389	2,851,053,022	3,145,804,411	3,886,644,826	7,032,449,237
2018	20,737,727	36,763,706	57,501,433	291,101,896	2,854,161,861	3,145,263,757	3,944,146,259	7,089,410,015
2019	20,242,770	33,524,276	53,767,046	288,118,242	2,860,908,855	3,149,027,097	3,997,913,304	7,146,940,401
2020	18,901,826	36,851,093	55,752,919	286,648,123	2,864,731,745	3,151,379,868	4,053,666,224	7,205,046,091
2021	18,061,791	37,484,735	55,546,526	286,192,355	2,868,327,733	3,154,520,088	4,109,212,750	7,263,732,838
2022	17,858,837	37,994,529	55,853,366	286,115,602	2,871,824,734	3,157,940,336	4,165,066,116	7,323,006,452
2023	17,759,916	38,243,252	56,003,168	286,315,591	2,875,487,927	3,161,803,518	4,221,069,284	7,382,872,802
2024	17,747,451	36,274,509	54,021,960	286,707,644	2,881,538,928	3,168,246,572	4,275,091,244	7,443,337,816
2025	17,890,520	36,589,675	54,480,195	287,138,023	2,887,698,018	3,174,836,041	4,329,571,439	7,504,407,480
2026	18,282,802	38,253,612	56,536,414	287,359,329	2,892,620,658	3,179,979,987	4,386,107,853	7,566,087,840
2027	18,429,649	37,549,607	55,979,256	287,618,829	2,898,679,066	3,186,297,895	4,442,087,109	7,628,385,004
2028	18,595,540	38,577,312	57,172,852	287,899,331	2,904,145,849	3,192,045,180	4,499,259,961	7,691,305,140
2029	18,799,987	41,093,737	59,893,724	288,164,145	2,907,536,648	3,195,700,793	4,559,153,684	7,754,854,477

(continued)

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
2030	18,818,239	35,688,561	54,506,800	288,601,355	2,916,777,468	3,205,378,823	4,613,660,484	7,819,039,307
2031	18,827,621	34,462,627	53,290,248	289,221,737	2,927,693,516	3,216,915,253	4,666,950,733	7,883,865,986
2032	18,692,543	35,348,754	54,041,297	290,171,679	2,938,177,224	3,228,348,903	4,720,992,029	7,949,340,932
2033	18,520,273	39,513,904	58,034,177	291,490,315	2,944,954,107	3,236,444,422	4,779,026,206	8,015,470,628
2034	18,879,923	41,996,400	60,876,323	292,647,690	2,949,711,401	3,242,359,091	4,839,902,529	8,082,261,620
2035	19,208,472	42,193,540	61,402,012	293,676,888	2,954,739,092	3,248,415,980	4,901,304,542	8,149,720,522
2036	19,253,246	43,405,016	62,658,262	294,863,690	2,959,027,520	3,253,891,210	4,963,962,803	8,217,854,013
2037	19,181,472	43,334,025	62,515,497	296,326,666	2,963,863,873	3,260,190,539	5,026,478,300	8,286,668,839
2038	18,816,832	44,200,367	63,017,199	298,360,726	2,968,315,588	3,266,676,314	5,089,495,500	8,356,171,813
2039	18,640,380	44,540,956	63,181,336	300,779,747	2,972,913,235	3,273,692,982	5,152,676,835	8,426,369,817
2040	18,868,614	43,522,480	62,391,094	303,181,128	2,979,020,744	3,282,201,872	5,215,067,929	8,497,269,801
2041	19,167,716	44,688,758	63,856,474	305,496,107	2,984,458,275	3,289,954,382	5,278,924,403	8,568,878,785
2042	19,382,040	46,940,250	66,322,290	307,811,589	2,988,145,577	3,295,957,166	5,345,246,693	8,641,203,859
2043	19,541,341	47,422,508	66,963,849	310,184,745	2,991,856,896	3,302,041,641	5,412,210,542	8,714,252,183
2044	19,770,034	43,607,011	63,377,045	312,548,353	2,999,895,050	3,312,443,403	5,475,587,587	8,788,030,990
2045	19,973,320	41,119,753	61,093,073	314,930,012	3,010,936,914	3,325,866,926	5,536,680,660	8,862,547,586
2046	20,168,196	44,873,307	65,041,503	317,340,344	3,018,746,840	3,336,087,184	5,601,722,164	8,937,809,348
2047	20,360,725	48,025,392	68,386,117	319,783,934	3,023,931,514	3,343,715,448	5,670,108,280	9,013,823,728
2048	20,459,107	49,669,560	70,128,667	322,357,184	3,028,004,120	3,350,361,304	5,740,236,947	9,090,598,251
2049	20,564,544	49,477,271	70,041,815	325,055,321	3,032,806,437	3,357,861,758	5,810,278,762	9,168,140,520

Table B-1. Historical and Forecasted Wood Waste Generated and Wood Remaining In Service in the United States, 1900–2065 (continued)

Year	Gen. of Treated Wood Waste	Gen. of Untreated Wood Waste	Gen. of Total Wood Waste	Treated Wood In Service	Untreated Wood In Service	Total Wood In Service	Cumul. Wood Waste Gen	Cumul. Wood In Service
2050	20,804,219	45,102,811	65,907,030	327,746,409	3,042,526,010	3,370,272,419	5,876,185,792	9,246,458,211
2051	21,001,412	42,639,850	63,641,262	330,475,258	3,055,256,768	3,385,732,026	5,939,827,053	9,325,559,079
2052	21,319,913	43,174,148	64,494,061	333,122,907	3,068,006,934	3,401,129,841	6,004,321,115	9,405,450,956
2053	21,534,588	48,508,880	70,043,468	335,795,558	3,075,981,611	3,411,777,169	6,074,364,583	9,486,141,752
2054	21,668,193	52,407,420	74,075,613	338,576,676	3,080,622,583	3,419,199,259	6,148,440,196	9,567,639,455
2055	21,719,712	53,216,863	74,936,575	341,550,768	3,085,024,596	3,426,575,364	6,223,376,771	9,649,952,135
2056	21,620,990	54,631,220	76,252,210	344,870,520	3,088,588,441	3,433,458,961	6,299,628,981	9,733,087,942
2057	21,673,450	54,832,981	76,506,431	348,387,220	3,092,532,476	3,440,919,696	6,376,135,412	9,817,055,108
2058	21,889,778	50,053,582	71,943,360	351,939,493	3,101,843,680	3,453,783,173	6,448,078,772	9,901,861,945
2059	22,177,076	48,330,248	70,507,324	355,458,889	3,113,471,866	3,468,930,755	6,518,586,097	9,987,516,851
2060	22,398,848	46,944,556	69,343,404	359,013,477	3,127,085,328	3,486,098,805	6,587,929,501	10,074,028,305
2061	22,622,836	44,905,109	67,527,945	362,603,612	3,143,343,817	3,505,947,429	6,655,457,445	10,161,404,874
2062	22,849,064	46,784,240	69,633,304	366,229,648	3,158,334,811	3,524,564,459	6,725,090,749	10,249,655,208
2063	23,077,556	47,761,975	70,839,531	369,891,944	3,172,965,823	3,542,857,767	6,795,930,280	10,338,788,046
2064	23,308,330	48,651,277	71,959,607	373,590,863	3,187,331,462	3,560,922,325	6,867,889,887	10,428,812,212
2065	23,541,414	48,334,778	71,876,192	377,326,772	3,202,643,770	3,579,970,542	6,939,766,079	10,519,736,620

Table B-2. Estimated Wood Waste Generated by U.S. Region, 1900–2065

Year	South	West	Midwest	Northeast	Total Wood Waste Generated	Cumul. Wood Waste Generated
1900	0	0	0	0	0	0
1901	0	0	0	0	0	0
1902	0	0	0	0	0	0
1903	0	0	0	0	0	0
1904	0	0	0	0	0	0
1905	0	0	0	0	0	0
1906	5,318,590	0	0	0	5,318,590	5,318,590
1907	5,560,331	0	0	0	5,560,331	10,878,921
1908	5,821,309	0	0	0	5,821,309	16,700,230
1909	6,107,498	0	0	0	6,107,498	22,807,728
1910	6,265,496	0	0	1,063,718	7,329,214	30,136,942
1911	6,358,893	0	0	1,112,066	7,470,959	37,607,901
1912	6,813,810	2,659,295	1,595,577	1,164,262	12,232,944	49,840,845
1913	7,211,649	2,780,165	1,668,099	1,221,500	12,881,413	62,722,258
1914	6,588,140	2,910,654	1,746,393	1,253,099	12,498,286	75,220,544
1915	8,816,665	3,053,749	1,832,250	1,271,779	14,974,443	90,194,986
1916	8,926,747	3,132,748	1,879,649	1,362,762	15,301,906	105,496,892
1917	8,777,116	3,179,447	1,907,668	1,442,330	15,306,561	120,803,453
1918	9,064,581	3,406,905	2,044,143	1,317,628	15,833,257	136,636,709
1919	8,989,586	3,605,824	2,163,495	1,397,680	16,156,585	152,793,294
1920	8,580,431	3,294,070	1,976,442	1,403,077	15,254,019	168,047,313
1921	8,298,562	3,494,200	2,096,520	1,355,208	15,244,490	183,291,804
1922	8,788,892	3,507,692	2,104,615	1,393,026	15,794,225	199,086,029
1923	8,130,381	3,388,020	2,032,812	1,367,164	14,918,378	214,004,406
1924	9,066,067	3,482,564	2,089,539	1,278,912	15,917,082	229,921,488
1925	9,405,271	3,417,911	2,050,747	1,556,916	16,430,845	246,352,333
1926	9,400,173	3,197,280	1,918,368	1,644,250	16,160,072	262,512,405
1927	8,693,504	2,978,158	1,786,895	1,573,357	15,031,913	277,544,319
1928	9,230,375	3,154,944	1,892,967	1,519,963	15,798,249	293,342,567
1929	9,682,222	2,932,854	1,759,713	1,586,235	15,961,024	309,303,591
1930	9,459,433	3,664,315	2,198,589	1,596,674	16,919,010	326,222,601
1931	9,587,696	3,844,387	2,306,632	1,461,095	17,199,810	343,422,411
1932	9,191,345	3,899,286	2,339,572	1,597,798	17,028,001	360,450,412

(continued)

Table B-2. Estimated Wood Waste Generated by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood Waste Generated	Cumul. Wood Waste Generated
1933	8,858,599	3,531,339	2,118,804	1,671,551	16,180,294	376,630,706
1934	8,827,832	3,831,874	2,299,125	1,664,738	16,623,569	393,254,275
1935	9,027,051	4,139,477	2,483,686	1,650,532	17,300,746	410,555,021
1936	7,640,870	4,131,839	2,479,103	1,612,623	15,864,435	426,419,456
1937	6,593,852	4,160,064	2,496,038	1,566,680	14,816,635	441,236,090
1938	5,885,871	3,999,263	2,399,558	1,531,409	13,816,100	455,052,190
1939	6,093,985	3,920,699	2,352,420	1,550,007	13,917,111	468,969,301
1940	6,362,288	3,859,385	2,315,631	1,524,413	14,061,717	483,031,018
1941	6,664,080	3,940,583	2,364,350	1,317,961	14,286,975	497,317,993
1942	7,045,543	3,402,701	2,041,621	1,136,462	13,626,327	510,944,320
1943	7,259,546	2,777,137	1,666,282	1,196,463	12,899,428	523,843,747
1944	6,807,861	2,295,346	1,377,208	1,266,135	11,746,551	535,590,298
1945	6,675,864	2,401,517	1,440,910	1,358,769	11,877,059	547,467,357
1946	6,603,923	2,571,569	1,542,942	1,433,853	12,152,286	559,619,644
1947	7,117,087	2,713,142	1,627,885	1,528,596	12,986,709	572,606,353
1948	7,195,270	3,513,413	2,108,048	1,433,369	14,250,100	586,856,452
1949	6,989,950	3,686,842	2,212,105	1,527,607	14,416,503	601,272,955
1950	7,002,584	3,448,747	2,069,248	1,567,917	25,722,911	626,995,866
1951	6,587,181	3,557,977	2,134,786	1,683,010	26,126,179	653,122,045
1952	7,266,476	3,780,858	2,268,515	1,669,213	27,719,175	680,841,220
1953	7,298,379	4,223,643	2,534,186	1,601,910	29,018,270	709,859,490
1954	7,224,976	4,239,375	2,543,625	1,576,682	29,290,431	739,149,921
1955	6,381,809	4,137,643	2,482,586	1,370,210	28,282,327	767,432,249
1956	7,116,680	3,994,151	2,396,491	1,430,686	29,843,216	797,275,465
1957	7,111,363	3,715,096	2,229,058	1,388,249	30,219,248	827,494,712
1958	7,043,245	4,015,292	2,409,175	1,402,017	29,281,285	856,775,998
1959	7,138,858	4,113,202	2,467,921	1,297,975	30,305,079	887,081,077
1960	7,037,384	3,949,806	2,369,883	1,465,613	30,168,837	917,249,914
1961	7,555,865	3,400,291	2,040,174	1,451,477	29,270,395	946,520,309
1962	7,524,606	3,554,475	2,132,685	1,483,948	29,931,931	976,452,240
1963	7,245,972	3,528,124	2,116,874	1,480,194	29,324,526	1,005,776,766
1964	7,162,571	3,591,580	2,154,948	1,495,628	28,392,829	1,034,169,595
1965	8,099,884	3,637,589	2,182,554	1,558,476	28,507,942	1,062,677,537

(continued)

Table B-2. Estimated Wood Waste Generated by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood Waste Generated	Cumul. Wood Waste Generated
1966	7,365,010	3,675,623	2,205,374	1,605,582	28,654,469	1,091,332,006
1967	7,218,479	3,867,616	2,320,569	1,515,326	27,753,226	1,119,085,232
1968	7,385,480	3,792,222	2,275,333	1,510,130	26,995,209	1,146,080,441
1969	7,606,571	3,585,199	2,151,119	1,624,375	27,605,350	1,173,685,791
1970	8,121,224	3,729,994	2,237,997	1,396,073	55,314,287	1,229,000,079
1971	8,155,210	4,186,411	2,511,847	1,371,222	55,462,603	1,284,462,681
1972	8,076,929	3,813,661	2,288,197	1,382,650	57,327,458	1,341,790,139
1973	7,776,165	3,719,576	2,231,746	1,470,787	59,700,584	1,401,490,723
1974	8,369,925	3,777,471	2,266,482	1,492,656	60,839,798	1,462,330,521
1975	8,159,446	3,828,193	2,296,916	1,556,269	61,075,132	1,523,405,653
1976	8,051,142	4,067,243	2,440,346	1,584,950	63,465,305	1,586,870,958
1977	8,601,152	4,116,008	2,469,605	1,554,022	65,448,357	1,652,319,316
1978	9,007,014	4,019,545	2,411,727	1,583,644	62,258,463	1,714,577,779
1979	9,183,319	3,680,159	2,208,096	1,610,368	64,496,684	1,779,074,463
1980	8,373,093	3,835,289	2,301,173	1,622,644	61,589,253	1,840,663,716
1981	7,854,713	3,885,795	2,331,477	1,749,841	57,417,622	1,898,081,338
1982	8,499,502	3,867,742	2,320,645	1,781,605	57,254,401	1,955,335,739
1983	9,281,660	4,162,223	2,497,334	1,780,884	58,641,041	2,013,976,780
1984	9,396,784	4,363,680	2,618,208	1,651,660	57,175,112	2,071,151,892
1985	9,204,595	4,440,181	2,664,109	1,489,172	55,659,336	2,126,811,228
1986	8,582,334	3,980,021	2,388,013	1,649,543	57,496,771	2,184,307,999
1987	8,386,966	3,736,950	2,242,170	1,783,678	55,214,202	2,239,522,201
1988	8,446,209	4,122,131	2,473,279	1,859,446	52,919,068	2,292,441,270
1989	9,244,468	4,577,271	2,746,362	1,820,718	56,789,189	2,349,230,458
1990	9,565,154	4,581,255	2,748,753	1,684,530	57,570,955	2,406,801,413
1991	9,879,777	4,464,305	2,678,583	1,609,643	54,819,340	2,461,620,752
1992	10,573,148	4,069,368	2,441,621	1,593,298	57,635,425	2,519,256,177
1993	11,080,032	3,883,903	2,330,342	1,828,459	60,481,901	2,579,738,079
1994	10,818,753	3,997,689	2,398,613	1,923,268	59,372,579	2,639,110,657
1995	10,679,549	4,553,661	2,732,197	1,953,068	58,552,054	2,697,662,712
1996	10,325,002	4,797,179	2,878,307	2,075,599	59,561,768	2,757,224,480
1997	9,738,922	4,752,410	2,851,446	2,160,797	57,843,881	2,815,068,361
1998	10,278,813	5,091,136	3,054,681	2,127,641	58,271,771	2,873,340,132

(continued)

Table B-2. Estimated Wood Waste Generated by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood Waste Generated	Cumul. Wood Waste Generated
1999	10,509,519	5,295,402	3,177,241	2,104,095	58,619,711	2,931,959,843
2000	10,853,191	5,182,848	3,109,709	1,984,190	54,336,962	2,986,296,804
2001	11,045,687	5,289,579	3,173,747	1,910,669	48,289,084	3,034,585,889
2002	11,348,703	5,190,649	3,114,390	2,027,158	44,350,329	3,078,936,217
2003	11,352,404	4,928,772	2,957,263	2,093,841	45,940,566	3,124,876,783
2004	11,348,405	4,965,585	2,979,351	2,126,553	47,061,873	3,171,938,656
2005	11,426,304	4,930,828	2,958,497	2,052,297	49,792,409	3,221,731,066
2006	11,150,378	5,135,497	3,081,298	2,050,182	52,780,635	3,274,511,701
2007	11,250,632	5,252,698	3,151,619	2,061,706	53,254,989	3,327,766,690
2008	11,680,681	5,272,528	3,163,517	2,179,649	51,281,493	3,379,048,183
2009	11,676,948	5,289,592	3,173,755	2,265,666	54,868,353	3,433,916,536
2010	12,441,162	5,248,611	3,149,167	2,256,221	55,155,226	3,489,071,762
2011	12,659,818	5,352,740	3,211,645	2,256,520	58,758,008	3,547,829,770
2012	12,270,479	5,346,380	3,207,828	2,351,473	58,797,414	3,606,627,184
2013	11,472,410	5,403,152	3,241,891	2,322,713	57,491,879	3,664,119,064
2014	9,765,128	5,623,410	3,374,046	2,429,260	56,290,965	3,720,410,029
2015	8,731,342	5,582,162	3,349,297	2,408,027	52,364,350	3,772,774,379
2016	8,763,269	6,034,001	3,620,400	2,321,367	56,404,182	3,829,178,561
2017	9,330,659	6,155,928	3,693,557	2,197,698	57,466,265	3,886,644,826
2018	9,386,710	5,923,260	3,553,956	1,873,800	57,501,433	3,944,146,259
2019	9,659,263	5,551,197	3,330,719	1,701,591	53,767,046	3,997,913,304
2020	9,766,452	4,666,857	2,800,114	1,668,403	55,752,919	4,053,666,224
2021	9,710,074	4,127,987	2,476,792	1,746,939	55,546,526	4,109,212,750
2022	9,502,220	4,120,557	2,472,335	1,763,726	55,853,366	4,165,066,116
2023	9,016,859	4,319,097	2,591,458	1,832,503	56,003,168	4,221,069,284
2024	8,752,568	4,446,122	2,667,673	1,881,088	54,021,960	4,275,091,244
2025	8,766,525	4,520,075	2,712,045	1,891,875	54,480,195	4,329,571,439
2026	9,031,212	4,592,092	2,755,255	1,904,243	56,536,414	4,386,107,853
2027	9,086,589	4,619,764	2,771,859	1,951,437	55,979,256	4,442,087,109
2028	9,313,064	4,583,951	2,750,371	1,948,154	57,172,852	4,499,259,961
2029	9,408,040	4,614,506	2,768,703	2,008,738	59,893,724	4,559,153,684
2030	9,399,942	4,628,043	2,776,826	2,013,429	54,506,800	4,613,660,484
2031	9,287,488	4,729,698	2,837,818	1,972,617	53,290,248	4,666,950,733

(continued)

Table B-2. Estimated Wood Waste Generated by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood Waste Generated	Cumul. Wood Waste Generated
2032	8,985,465	4,854,601	2,912,761	1,939,715	54,041,297	4,720,992,029
2033	8,870,632	4,881,418	2,928,851	1,839,372	58,034,177	4,779,026,206
2034	8,958,830	5,077,581	3,046,549	1,796,964	60,876,323	4,839,902,529
2035	9,133,919	5,166,664	3,099,998	1,807,891	61,402,012	4,901,304,542
2036	9,225,259	5,108,504	3,065,102	1,854,381	62,658,262	4,963,962,803
2037	9,317,511	4,993,582	2,996,149	1,874,230	62,515,497	5,026,478,300
2038	9,410,687	4,693,299	2,815,980	1,896,866	63,017,199	5,089,495,500
2039	9,504,794	4,507,323	2,704,394	1,923,869	63,181,336	5,152,676,835
2040	9,599,841	4,582,642	2,749,585	1,936,546	62,391,094	5,215,067,929
2041	9,695,840	4,706,574	2,823,944	1,941,358	63,856,474	5,278,924,403
2042	9,792,798	4,762,461	2,857,477	1,969,304	66,322,290	5,345,246,693
2043	9,890,726	4,792,879	2,875,727	1,982,010	66,963,849	5,412,210,542
2044	9,989,634	4,844,655	2,906,794	2,028,952	63,377,045	5,475,587,587
2045	10,089,529	4,896,363	2,937,818	2,049,610	61,093,073	5,536,680,660
2046	10,190,424	4,955,063	2,973,038	2,049,671	65,041,503	5,601,722,164
2047	10,292,329	5,024,699	3,014,820	2,028,877	68,386,117	5,670,108,280
2048	10,395,252	5,058,543	3,035,125	1,970,186	70,128,667	5,740,236,947
2049	10,499,205	5,072,743	3,043,646	1,948,950	70,041,815	5,810,278,762
2050	10,604,197	5,144,802	3,086,881	1,968,338	65,907,030	5,876,185,792
2051	10,710,239	5,178,782	3,107,269	2,005,122	63,641,262	5,939,827,053
2052	10,817,341	5,298,374	3,179,025	2,025,173	64,494,061	6,004,321,115
2053	10,925,514	5,352,281	3,211,369	2,045,425	70,043,468	6,074,364,583
2054	11,034,770	5,354,715	3,212,829	2,065,879	74,075,613	6,148,440,196
2055	11,145,118	5,305,036	3,183,021	2,086,538	74,936,575	6,223,376,771
2056	11,256,568	5,160,637	3,096,382	2,107,403	76,252,210	6,299,628,981
2057	11,369,134	5,109,899	3,065,939	2,128,477	76,506,431	6,376,135,412
2058	11,482,826	5,160,744	3,096,446	2,149,762	71,943,360	6,448,078,772
2059	11,597,654	5,255,102	3,153,061	2,171,260	70,507,324	6,518,586,097
2060	11,713,631	5,307,653	3,184,592	2,192,972	69,343,404	6,587,929,501
2061	11,830,766	5,360,730	3,216,438	2,214,902	67,527,945	6,655,457,445
2062	11,949,074	5,414,337	3,248,602	2,237,051	69,633,304	6,725,090,749
2063	12,068,565	5,468,481	3,281,088	2,259,422	70,839,531	6,795,930,280
2064	12,189,251	5,523,165	3,313,899	2,282,016	71,959,607	6,867,889,887
2065	12,311,144	5,578,396	3,347,038	2,304,836	71,876,192	6,939,766,079

Table B-3. Estimated Wood Remaining In Service by U.S. Region, 1900–2065

Year	South	West	Midwest	Northeast	Total Wood In Service	Cumul. Wood In Service
1900	8,310,297	4,155,149	2,493,089	1,662,060	55,401,983	55,401,983
1901	8,688,017	4,344,008	2,606,405	1,737,603	113,322,096	113,322,096
1902	9,095,795	4,547,897	2,728,739	1,819,159	173,960,728	173,960,728
1903	9,542,966	4,771,483	2,862,890	1,908,593	237,580,502	237,580,502
1904	9,789,838	4,894,919	2,936,951	1,957,968	302,846,089	302,846,089
1905	9,935,770	4,967,886	2,980,731	1,987,154	369,084,559	369,084,559
1906	5,327,988	5,323,289	3,193,974	2,129,316	434,743,156	440,061,746
1907	5,707,871	5,634,100	3,380,461	2,253,640	504,304,168	515,183,089
1908	4,472,660	5,146,984	3,088,191	2,058,794	567,109,316	583,809,546
1909	4,811,877	5,459,687	3,275,812	2,183,875	633,797,648	656,605,376
1910	4,696,040	5,480,769	3,288,461	1,128,589	699,545,343	729,682,285
1911	4,228,671	5,293,782	3,176,269	1,005,447	762,658,141	800,266,042
1912	4,069,203	2,782,211	1,669,327	1,012,341	822,978,618	872,819,463
1913	3,469,323	2,560,321	1,536,193	914,695	881,303,686	944,025,944
1914	3,403,362	2,085,096	1,251,058	745,201	935,415,410	1,010,635,954
1915	490,077	1,599,623	959,773	589,570	982,485,918	1,072,680,904
1916	932,454	1,796,852	1,078,111	609,078	1,032,912,015	1,138,408,907
1917	388,053	1,403,138	841,883	390,704	1,078,706,584	1,199,510,037
1918	-470,263	890,254	534,152	401,236	1,120,168,778	1,256,805,487
1919	37,618	907,778	544,667	407,761	1,164,193,554	1,316,986,848
1920	478,160	1,235,225	741,135	408,642	1,209,330,144	1,377,377,457
1921	-543,521	383,320	229,992	195,800	1,245,785,930	1,429,077,733
1922	-179,542	796,983	478,190	328,844	1,287,387,374	1,486,473,402
1923	1,390,063	1,372,202	823,321	536,924	1,335,938,619	1,549,943,025
1924	186,166	1,143,553	686,131	571,534	1,381,703,089	1,611,624,577
1925	-278,515	1,145,467	687,280	268,435	1,426,117,281	1,672,469,614
1926	-441,029	1,282,292	769,375	147,578	1,469,684,836	1,732,197,241
1927	-194,853	1,271,167	762,701	126,374	1,511,310,599	1,788,854,917
1928	-937,825	991,331	594,798	138,547	1,550,796,014	1,844,138,581
1929	-1,007,375	1,404,570	842,742	148,734	1,592,667,304	1,901,970,895
1930	-2,567,028	-218,112	-130,867	-218,193	1,621,697,662	1,947,920,263
1931	-4,580,729	-1,340,903	-804,542	-459,701	1,637,877,638	1,981,300,049
1932	-5,452,965	-2,030,097	-1,218,058	-850,122	1,645,772,167	2,006,222,579

(continued)

Table B-3. Estimated Wood Remaining In Service by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood In Service	Cumul. Wood In Service
1933	-4,553,052	-1,378,566	-827,140	-810,442	1,658,295,517	2,034,926,223
1934	-4,180,779	-1,508,348	-905,008	-735,328	1,672,652,307	2,065,906,582
1935	-3,699,012	-1,475,457	-885,274	-584,925	1,690,871,823	2,101,426,844
1936	-1,433,628	-1,028,218	-616,930	-371,175	1,716,389,001	2,142,808,457
1937	-76,077	-901,177	-540,706	-263,125	1,745,024,201	2,186,260,291
1938	-212,133	-1,162,394	-697,436	-396,662	1,769,033,018	2,224,085,208
1939	271,373	-738,020	-442,812	-276,935	1,797,551,629	2,266,520,930
1940	351,901	-502,290	-301,374	-181,575	1,828,251,175	2,311,282,193
1941	1,088,702	-64,192	-38,515	232,595	1,865,649,417	2,362,967,410
1942	693,109	466,625	279,975	411,268	1,903,614,106	2,414,558,426
1943	68,348	886,810	532,086	269,116	1,939,567,305	2,463,411,052
1944	342,350	1,279,759	767,855	163,907	1,975,488,825	2,511,079,123
1945	-376,212	748,309	448,985	-98,838	2,005,609,440	2,553,076,797
1946	695,466	1,078,125	646,875	26,025	2,042,119,742	2,601,739,386
1947	438,660	1,064,732	638,839	-17,447	2,079,504,676	2,652,111,029
1948	397,949	283,197	169,918	85,275	2,115,876,031	2,702,732,483
1949	-421,650	-402,692	-241,615	-213,947	2,145,248,192	2,746,521,147
1950	634,440	369,766	221,859	-40,512	2,170,438,775	2,797,434,641
1951	922,324	196,776	118,066	-181,109	2,194,375,965	2,847,498,010
1952	203,087	-46,077	-27,646	-175,300	2,216,453,880	2,897,295,100
1953	232,693	-458,107	-274,864	-95,695	2,237,642,757	2,947,502,247
1954	247,598	-503,088	-301,853	-82,167	2,258,169,487	2,997,319,408
1955	1,489,302	-202,087	-121,253	204,012	2,282,361,236	3,049,793,484
1956	802,098	-34,762	-20,857	153,070	2,305,309,875	3,102,585,340
1957	207,877	-55,476	-33,286	75,599	2,323,885,562	3,151,380,274
1958	421,691	-282,825	-169,695	90,970	2,344,370,512	3,201,146,510
1959	1,196,062	54,258	32,555	369,010	2,369,631,566	3,256,712,643
1960	196,220	-333,004	-199,802	-18,893	2,387,686,758	3,304,936,672
1961	-447,630	153,827	92,296	-29,830	2,405,804,594	3,352,324,903
1962	-137,707	138,975	83,385	-6,568	2,425,118,653	3,401,570,893
1963	692,548	441,136	264,682	107,510	2,448,717,591	3,454,494,357
1964	1,224,405	601,908	361,145	181,767	2,476,237,934	3,510,407,529
1965	267,732	546,219	327,731	115,047	2,503,514,096	3,566,191,633

(continued)

Table B-3. Estimated Wood Remaining In Service by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood In Service	Cumul. Wood In Service
1966	1,078,187	545,976	327,586	83,057	2,531,147,608	3,622,479,613
1967	928,891	206,069	123,642	114,149	2,557,710,182	3,676,795,414
1968	1,156,800	478,919	287,351	198,326	2,587,663,509	3,733,743,950
1969	1,013,308	724,740	434,844	99,601	2,617,524,015	3,791,209,806
1970	381,262	521,249	312,749	304,424	2,618,892,969	3,847,893,047
1971	1,097,422	439,905	263,943	479,304	2,625,114,573	3,909,577,254
1972	1,633,038	1,041,323	624,794	559,343	2,632,520,234	3,974,310,373
1973	1,967,943	1,152,477	691,486	478,034	2,637,780,366	4,039,271,089
1974	104,433	459,707	275,825	202,216	2,633,436,284	4,095,766,805
1975	-389,890	56,585	33,951	-2,358	2,624,158,192	4,147,563,845
1976	795,718	356,187	213,712	184,422	2,619,671,951	4,206,542,909
1977	1,141,769	755,452	453,271	394,562	2,619,176,400	4,271,495,715
1978	1,130,027	1,048,975	629,385	443,764	2,624,498,205	4,339,075,984
1979	721,204	1,272,102	763,261	370,537	2,626,031,675	4,405,106,138
1980	240,327	471,420	282,853	100,040	2,621,865,219	4,462,528,935
1981	175,568	129,346	77,607	-143,785	2,617,982,804	4,516,064,142
1982	-486,489	138,765	83,259	-179,002	2,614,148,494	4,569,484,233
1983	419,345	688,279	412,968	159,317	2,620,180,817	4,634,157,597
1984	1,031,035	850,229	510,138	433,904	2,632,524,496	4,703,676,388
1985	1,409,211	866,723	520,033	633,589	2,647,623,867	4,774,435,095
1986	2,720,457	1,671,374	1,002,824	611,015	2,665,479,030	4,849,787,029
1987	3,555,378	2,234,223	1,340,534	604,791	2,689,880,457	4,929,402,658
1988	3,193,494	1,697,720	1,018,632	468,494	2,714,559,407	5,007,000,677
1989	2,457,451	1,273,688	764,213	519,665	2,735,783,008	5,085,013,466
1990	1,683,198	1,042,920	625,753	565,141	2,753,201,063	5,160,002,476
1991	451,292	701,229	420,737	456,571	2,767,255,513	5,228,876,265
1992	299,011	1,366,712	820,027	581,134	2,782,101,145	5,301,357,322
1993	56,938	1,684,582	1,010,749	398,935	2,795,865,709	5,375,603,788
1994	555,611	1,689,494	1,013,696	351,605	2,812,322,227	5,451,432,884
1995	562,739	1,067,483	640,490	295,390	2,828,718,759	5,526,381,471
1996	1,084,688	907,666	544,600	206,339	2,845,221,591	5,602,446,071
1997	1,831,447	1,032,775	619,665	153,277	2,864,513,506	5,679,581,867
1998	1,546,350	821,446	492,868	237,392	2,885,076,156	5,758,416,287

(continued)

Table B-3. Estimated Wood Remaining In Service by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood In Service	Cumul. Wood In Service
1999	1,720,836	819,775	491,865	341,976	2,907,992,141	5,839,951,984
2000	1,265,124	876,309	525,786	439,472	2,934,443,940	5,920,740,744
2001	674,026	570,278	342,167	433,274	2,964,286,275	5,998,872,164
2002	792,942	880,173	528,104	401,171	3,000,880,246	6,079,816,463
2003	661,120	1,077,990	646,794	308,864	3,035,029,834	6,159,906,617
2004	1,753,889	1,585,562	951,338	493,906	3,075,316,590	6,247,255,246
2005	1,820,193	1,692,421	1,015,452	597,003	3,113,834,162	6,335,565,227
2006	1,498,745	1,189,064	713,439	479,642	3,145,381,012	6,419,892,713
2007	50,314	397,774	238,665	198,483	3,167,465,654	6,495,232,344
2008	-3,087,429	-975,901	-585,541	-460,999	3,173,472,510	6,552,520,693
2009	-4,459,818	-1,681,027	-1,008,616	-822,240	3,166,718,356	6,600,634,892
2010	-5,155,490	-1,605,775	-963,465	-799,087	3,160,134,279	6,649,206,041
2011	-4,690,566	-1,368,114	-820,869	-662,669	3,154,504,617	6,702,334,387
2012	-4,221,535	-1,321,908	-793,145	-741,684	3,149,366,833	6,755,994,017
2013	-3,342,975	-1,338,435	-803,061	-696,826	3,146,071,180	6,810,190,243
2014	-1,554,400	-1,518,046	-910,828	-787,115	3,144,518,402	6,864,928,431
2015	-438,506	-1,435,744	-861,447	-749,460	3,147,439,622	6,920,214,001
2016	-387,505	-1,846,119	-1,107,671	-646,214	3,146,873,866	6,976,052,427
2017	-871,137	-1,926,168	-1,155,701	-505,793	3,145,804,411	7,032,449,237
2018	-842,593	-1,651,202	-990,721	-164,977	3,145,263,757	7,089,410,015
2019	-1,029,705	-1,236,418	-741,851	24,320	3,149,027,097	7,146,940,401
2020	-1,050,599	-308,931	-185,358	74,768	3,151,379,868	7,205,046,091
2021	-907,061	273,519	164,112	13,664	3,154,520,088	7,263,732,838
2022	-611,177	324,963	194,978	14,483	3,157,940,336	7,323,006,452
2023	-36,906	170,880	102,528	-36,512	3,161,803,518	7,382,872,802
2024	317,184	88,754	53,252	-67,137	3,168,246,572	7,443,337,816
2025	393,925	60,150	36,090	-59,785	3,174,836,041	7,504,407,480
2026	220,843	33,935	20,361	-53,833	3,179,979,987	7,566,087,840
2027	257,986	52,523	31,514	-82,522	3,186,297,895	7,628,385,004
2028	124,957	135,059	81,035	-60,550	3,192,045,180	7,691,305,140
2029	124,360	151,694	91,017	-102,258	3,195,700,793	7,754,854,477
2030	227,783	185,820	111,492	-87,884	3,205,378,823	7,819,039,307
2031	436,513	132,304	79,382	-27,816	3,216,915,253	7,883,865,986
2032	835,777	56,019	33,612	24,533	3,228,348,903	7,949,340,932

(continued)

Table B-3. Estimated Wood Remaining In Service by U.S. Region, 1900–2065 (continued)

Year	South	West	Midwest	Northeast	Total Wood In Service	Cumul. Wood In Service
2033	1,048,823	78,309	46,986	144,519	3,236,444,422	8,015,470,628
2034	1,059,819	-68,256	-40,954	206,766	3,242,359,091	8,082,261,620
2035	984,917	-107,246	-64,348	215,876	3,248,415,980	8,149,720,522
2036	994,765	1,509	905	189,623	3,253,891,210	8,217,854,013
2037	1,004,713	167,530	100,518	190,215	3,260,190,539	8,286,668,839
2038	1,014,760	519,424	311,654	188,223	3,266,676,314	8,356,171,813
2039	1,024,907	757,527	454,516	182,071	3,273,692,982	8,426,369,817
2040	1,035,156	734,856	440,914	190,453	3,282,201,872	8,497,269,801
2041	1,045,507	664,100	398,460	206,912	3,289,954,382	8,568,878,785
2042	1,055,963	661,920	397,152	200,448	3,295,957,166	8,641,203,859
2043	1,066,523	685,746	411,447	209,440	3,302,041,641	8,714,252,183
2044	1,077,188	688,755	413,253	184,413	3,312,443,403	8,788,030,990
2045	1,087,960	692,382	415,429	185,887	3,325,866,926	8,862,547,586
2046	1,098,840	689,569	413,741	208,182	3,336,087,184	8,937,809,348
2047	1,109,828	676,379	405,827	251,554	3,343,715,448	9,013,823,728
2048	1,120,926	699,546	419,728	333,050	3,350,361,304	9,090,598,251
2049	1,132,136	742,927	445,756	377,318	3,357,861,758	9,168,140,520
2050	1,143,456	729,025	437,415	381,193	3,370,272,419	9,246,458,211
2051	1,154,891	753,784	452,270	367,904	3,385,732,026	9,325,559,079
2052	1,166,440	693,517	416,110	371,583	3,401,129,841	9,405,450,956
2053	1,178,105	699,529	419,717	375,299	3,411,777,169	9,486,141,752
2054	1,189,887	757,613	454,568	379,052	3,419,199,259	9,567,639,455
2055	1,201,784	868,416	521,050	382,843	3,426,575,364	9,649,952,135
2056	1,213,802	1,074,549	644,729	386,671	3,433,458,961	9,733,087,942
2057	1,225,941	1,187,638	712,583	390,538	3,440,919,696	9,817,055,108
2058	1,238,200	1,199,768	719,862	394,443	3,453,783,173	9,901,861,945
2059	1,250,582	1,169,016	701,410	398,388	3,468,930,755	9,987,516,851
2060	1,263,088	1,180,707	708,424	402,371	3,486,098,805	10,074,028,305
2061	1,275,719	1,192,513	715,508	406,395	3,505,947,429	10,161,404,874
2062	1,288,476	1,204,438	722,663	410,459	3,524,564,459	10,249,655,208
2063	1,301,360	1,216,482	729,890	414,564	3,542,857,767	10,338,788,046
2064	1,314,374	1,228,648	737,189	418,709	3,560,922,325	10,428,812,212
2065	1,327,518	1,240,935	744,560	422,896	3,579,970,542	10,519,736,620